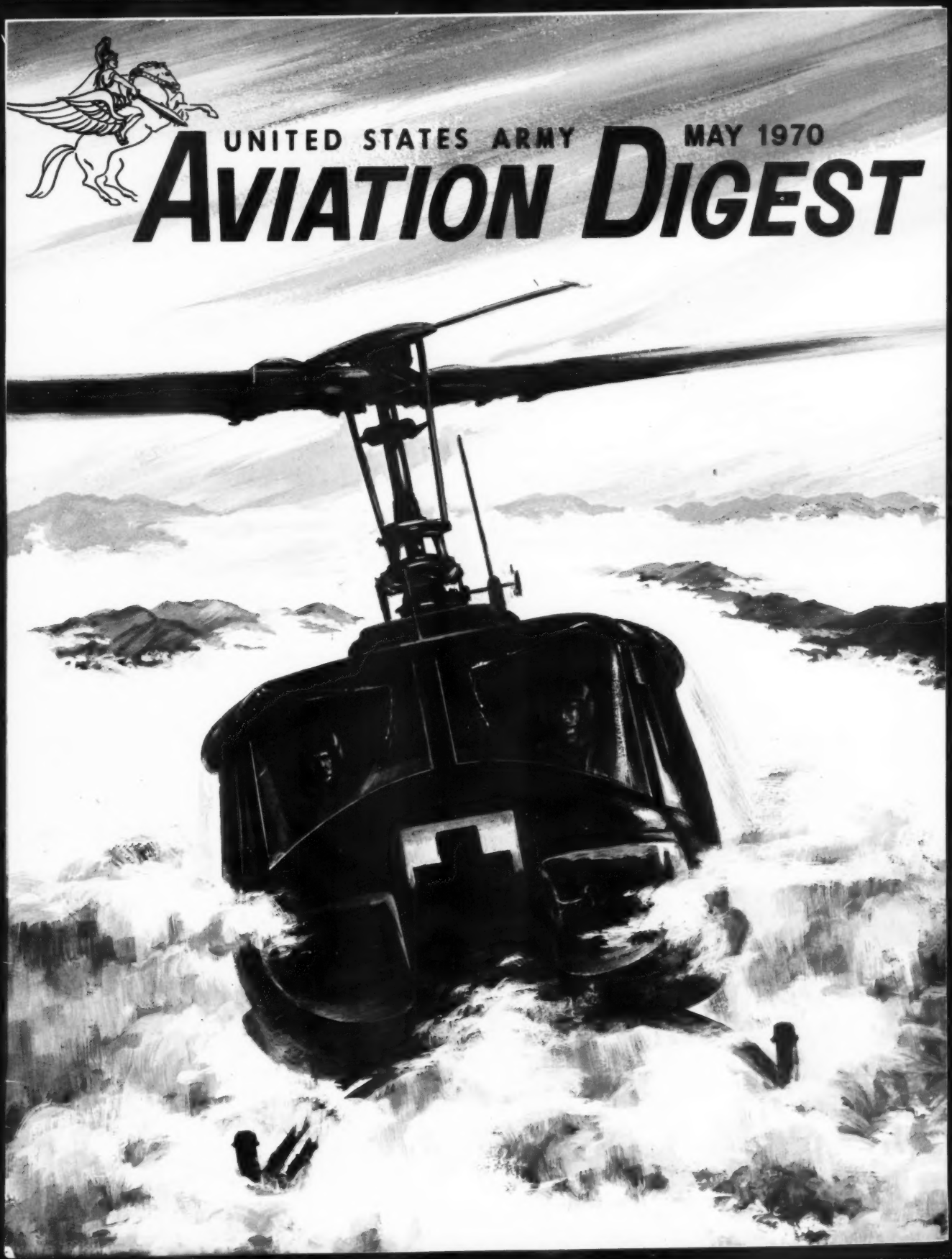
UNITED STATES ARMY
MAY 1970
AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

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ABOUT THE COVER

MAJ Pat Brady's medevac helicopter emerges from the fog-shrouded valley carrying its precious load of wounded soldiers. For his actions MAJ Brady was awarded the Medal of Honor (see articles on pages 1 and 12)

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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This month the DIGEST pays tribute to Major Patrick Brady—Army aviation's third Medal of Honor winner—by publishing two eyewitness accounts of his heroic actions. The first by Lieutenant Colonel William S. Augerson appears below while the second by Major Michael J. Scotti Jr., is on page 12. Army aviation's first two Medal of Honor winners were Specialist 4 Gary G. Wetzel ("Eyewitness To Valor," August 1969 DIGEST) and Warrant Officer Frederick E. Ferguson ("Stay Clear Of Hue," April 1970 DIGEST)

THE FIRST WEEK in January 1968 had brought a lot of war to the northern part of the Americal Division's area of operations in the I Corps area of the Republic of Vietnam. The 2nd North Vietnamese Army Division [well supplied with antiaircraft (AA) machineguns] had bet on the monsoon and was striking hard at our landing zones (LZ) and fire support bases (FSB).

On the night of 5 January we ran into big trouble down in the valley below us. The evening before a company attached to the 4th Battalion, 31st Infantry, had been boxed in and badly mauled by a large enemy force. Several aircraft attempting to help had been downed by the numerous AA machineguns in the valley.

By the time a relief company had reached the trapped unit, smoke and fog filled the valley. There were a lot of wounded down there—maybe 70 or so.

A 54th Dustoff helicopter, which had spent the night at FSB West hoping for a break in the weather, tried to hover down through the clouds at dawn with a sorting team and the battalion surgeon, Captain Mike Scotti. However, that kind of instrument flying was beyond the skill of the young warrant aviator and he sensibly returned to the FSB. Consequently, we were glad to see Major Pat Brady come striding up the hill to the command post.

After being briefed MAJ Brady made a few unsuccessful attempts to get through the fog. Finally he decided he had to give it another go and loaded up the sorting team and, as I recall, a chaplain. By then everyone was looking pretty serious and thoughtful.

I found out that Pat and his crew had just made a pickup from the middle of a Special Forces outpost west of us by hovering up a trail and blowing the fog out of the way—all the while getting a lot of fire from the enemy encircling the outpost.

MAJ Brady pulled pitch and they were off—skimming the clouds that lapped just below our perimeter wire. He went east until the fog thinned, then dropped down "on the deck" and started hovering back up the valley road through fog and an enemy regiment.

When he neared the casualties, MAJ Brady radioed the troops on the ground who guided him in by sound. They were less than 50 meters from the hostile forces and spoke softly on the radio. The cold, muddy, seriously wounded men were placed aboard his aircraft and MAJ Brady flew up through the fog to FSB West where we had an emergency medical facility. He then went through the same cycle three or four times and showed another Dustoff pilot how to get into the valley. Together they brought out 60 to 70 men.

During this time the wounded were given emergency care, sorted and flown out in slicks, Hooks and Dustoff aircraft to the 196th Infantry Brigade clearing station and to the 2nd Surgical (Mobile Army) and 1st Marine hospitals at Chu Lai.

Later the sun took the chill from the air and the fog lifted enough for us to see a few enemy troops watching from freshly dug positions on the other side of the valley. None of this bothered MAJ Brady who went on about his business.

In the afternoon when I stopped by the chopper pad at Chu Lai, I saw one of the UH-1s MAJ Brady had been flying earlier in the day. This one had had its controls shot up during a pickup. I subsequently learned that later in the day MAJ Brady made still another rescue and that he and his crew had evacuated six seriously wounded men from an enemy mine field south of Chu Lai (on the Batangan peninsula) amidst exploding mines which wounded some of his crew.

It would be impossible for an average person to keep up with MAJ Brady during a day in combat, but I feel honored to have seen some of the things he did which earned him the Medal of Honor.

Hospitals and doctors are not much help in combat without medics on the battlefield and men like Pat Brady who will get the wounded out despite the odds. One hopes all Dustoff units feel honored by MAJ Brady's award. —**Lieutenant Colonel William S. Augerson**

Assignment: USAREUR

Colonel Kenneth D. Mertel and Captain Robert E. Mitchell

A YOUNG aviator (Mr. New) sat in the auditorium with his newly graduating flight class, his thoughts not entirely on the words of the guest speaker. Several weeks ago he received word of his first assignment as a newly qualified aviator—Europe.

His mind wandered. A feeling of excitement? No! Instead a sense of foreboding as he thought of his forthcoming tour of duty. He had just completed the most thorough and advanced aviation training in the latest flying equipment; yet he would still be at a great disadvantage upon his arrival in Europe.

Throughout the months in flight school he had been an avid listener to war stories told in classrooms and over elbow-bending sessions at the bar. Etched in his mind were tales of "stone age" flying conditions and equipment which he would find in Europe. He pictured vividly an observation pilot, garbed in leather flying jacket complete with brightly colored scarf, climbing into his ancient L-4 to provide cover for combat air assaults flown in antique H-5 helicopters.

It could not be otherwise since for months he had heard only of the long funnel of personnel and equipment to Southeast Asia. To make matters worse he had even heard veterans returning from the Republic of Vietnam speaking of scarcity of personnel and equipment even in that high priority area.

So there he sits—a brand new aviator trained in latest helicopters, ready to employ the newest aviation techniques and tactics, destined to serve in what is to him the disaster area of Army aviation.

On his arrival in Europe Mr. New will, however, be in for a great surprise. Contrary to his expectations he will not find Army aviation straight out of "Those Magnificent Men and Their Flying Machines." He will be introduced to a command where there is not only the latest and most modern aircraft, but also a continual advancement in application of latest aviation techniques.

In the past, and in some aspects the recent past, many of Mr. New's thoughts were in one sense true though not to such a great extent. Other more pressing commitments for Army aviation did tend to drain assets which would normally have been available to Army aviation in Europe. Lack of assets did not, however, hold back thinking or planning by aviation personnel in Europe. Conditions merely required that U. S. Army Europe (USAREUR) adapt and modify new techniques to older types of equipment available.

In the past, as in the present, the preponderance of aviation personnel assigned to Europe have been experienced personnel with previous tours in other areas—primarily Vietnam to their credit. Through this input Army aviation in Europe amassed a vast store of flying knowledge and experience with which to update and improve aircraft employment.

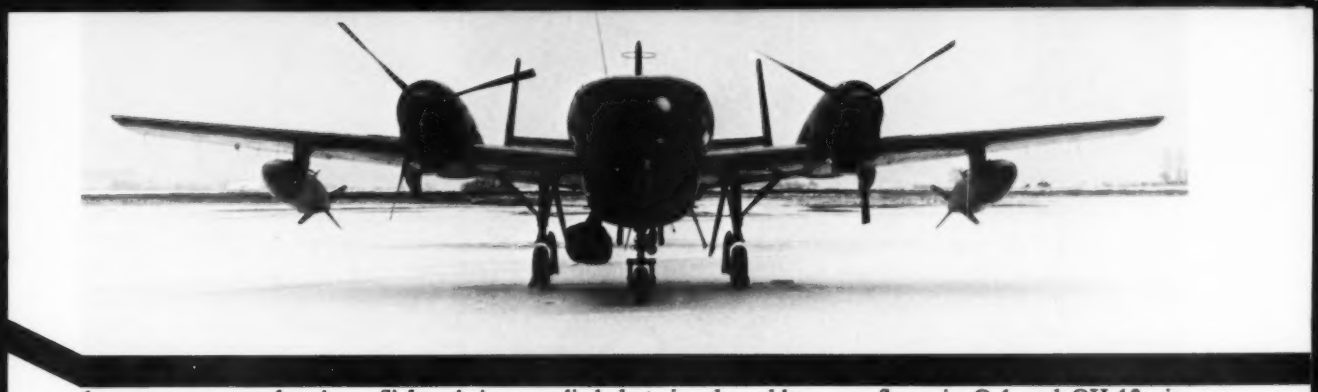
Input of experienced personnel alone could not in itself solve the problem. Ten experienced aviators could likely have experience in ten completely different aspects of flying. Through normal assignment a unit then might gain only one area of experience with the assignment of one aviator.

Thus the requirement was to consolidate experience of personnel assigned to Europe for dissemination to all units. This task is a primary function of the USAREUR Aviation Safety and Standardization Detachment, part of the 15th Aviation Group (Combat). The Safety and Standardization Detachment, or USAREUR Aviation School as it is informally called, functions as any flight school gathering knowledge through experienced instructors and disseminating it in instructional programs. Among courses of instruction available to aviators are CH-34 helicopter transition; a comprehensive instrument training program including both fixed wing and rotary wing refreshers as well as initial rotary wing training leading to a standard ticket; safety courses and other special courses applicable to aviation as required. In addition the school also conducts special courses such as AGM-22B Gunnery for personnel serving in aviation units in Europe.

Additionally the school performs an orientation function for all aviators assigned to Europe. Prior to performance of any flight duties each aviator must attend an initial briefing at the school located at Schwaebisch Hall, Germany, covering all aspects of flight operations in Europe. In addition to a 2-day initial classroom briefing each aviator must, in his unit, un-

When the authors wrote this article Colonel Mertel commanded the 15th Aviation Group (Combat) and Captain Mitchell was a member of that unit

Although aircraft such as this CH-34 Choctaw flying over Vilseck, Germany, are still being used, there has been a great influx of newer aircraft into the inventory in Europe. As a result, the newly assigned aviator will find the latest concepts of aircraft employment being carried out with a combination of new and old equipment



dergo a comprehensive flight orientation. This orientation includes day and night area flights. Every aviator also must demonstrate proficiency in instrument flight. For aviators possessing a standard instrument ticket or higher, a complete instrument flight is required. For all others performance of basic instrument maneuvers, ADF and GCA approaches plus accomplishment of a 180-degree turn under instrument conditions is required as a minimum.

At this point Mr. New is still partially correct in his thinking. The newest flight techniques are being applied but in the older types of aircraft. Yet here again his rapt attention to the purveyors of tall tales has caused him to be badly misinformed. Although most aviation units in Europe are equipped with a number of older types of aircraft, such as the O-1, U-6, CH-34 and the CH-37, there has been an influx of newer aircraft into the Army inventory in Europe.

As a result of this input Army aviation in Europe has for several years operated under latest concepts of employment with a combination of new and old equipment. Airmobile operations are routinely conducted with CH-34 troop carriers supported by UH-1B gunships. Cargo is moved by air in the CH-37 using techniques similar to those employed in Vietnam by the more modern CH-47. In the same respect observation and reconnaissance missions in Europe are flown in O-1 and OH-13 aircraft. The OV-1, a long time resident, was introduced to Europe long ago to increase capabilities of more outmoded methods of observation. With this aircraft Europe has been afforded a rapidly reacting surveillance and reconnaissance aircraft providing a capability for high speed photography and side looking airborne radar, a vast improvement over "eye ball" techniques, notebook, binoculars and hand held camera.

In January 1969 while still in the process of building up in-country assets, Army aviation in Europe put on its big show. The occasion was Reforger I (redeployment of forces to Germany; see DIGEST May 1969). With limited augmentation of aircraft and personnel from units assigned in CONUS and under the control of the 15th Combat Aviation Group, elements of USAREUR

Of the four aircraft pictured on these two pages, only the OH-6A Cayuse (above left) is not a permanent part of the Army in Europe inventory. This particular light observation helicopter was one of three used in recent Task Force Pegasus maneuvers and later redeployed. The CH-37 Mojave medium lift helicopter at left is operated by the 4th Aviation Company, 15th Aviation Group (CBT). Visual and electronic surveillance is carried out by the 122nd Aviation Company in OV-1 Mohawks (above right). The aircraft used in support of the general staff at USAREUR is the U-8 Seminole. At right, a U-8F awaits a mission

One of the two AH-1G HueyCobras used in Reforger I demonstrations and subsequently redeployed

Army aviation provided support for an Infantry battalion as the maneuver element of the exercise. Primary augmentation provided to Task Force Pegasus (as it was designated) were the newest type of aircraft in the Army inventory including three OH-6As, two AH-1Gs, two UH-1Hs, three CH-47s and two CH-54s. During the exercise each of the newer types of aircraft was called upon to demonstrate its capability and employment under simulated combat conditions to commanders and spectators. The task force of 90 helicopters successfully flew over 2,000 hours in preparation, in formation, in the worst weather in Germany and Europe during the month of January (no small feat itself) without incident.

To cap off performance of Army aviation in Reforger I, on 1 February 1969 Task Force Pegasus demonstrated techniques employed in performance of an airmobile air assault before an assemblage of commanders and many visiting dignitaries from all over Europe. In this demonstration all elements performed their roles in a fire supported air assault landing. Split-second timing from initial reconnaissance, firepower and troop airlift to the movement of heavy equipment was an awesome display of modern equipment capabilities and techniques available to Army aviation.

Upon completion of Reforger I the new equipment was redeployed to home stations in CONUS or to Vietnam with the exception of two CH-54 Flying Cranes. These two helicopters were joined in May 1969 by sister ships from the 295th Aviation Company (HH) arriving from Ft. Sill, Okla.

The arrival of CH-54s in Germany was a giant step in updating assets of Army aviation in Europe. Since the unit's arrival it has demonstrated the versatility of Army aviation. In 6 months of operations CH-54s have flown missions in all parts of Europe. Using the "people pods" the unit has moved personnel during numerous field exercises. It has recovered downed aircraft in locations as far removed as Scotland.

Another impressive accomplishment by the CH-54s was support of a field artillery battalion and an armored cavalry squadron for one week in the field. This mission was performed in conjunction with the joint German-American Operation Grosser Ruoesselsprung, a large German military maneuver held in northern Germany. Primary support performed by Flying Cranes in this operation was to move fuel and rations to rapidly moving ground combat units.

Although addition of the CH-54 to the inventory of aviation in Europe has been one of the most impressive single improvements, there have been and are continuing to be other improvements in aircraft assets. Significantly in the past the most modern aircraft in USAREUR has been the UH-1B which because of its versatility has performed many functions. Among these is its primary role of aerial weaponry with a secondary mission of command and control.

The primary mode of troop transportation in airmobile operations has been, and will be for a while at least, the CH-34, the work horse of aviation in Europe. This aircraft also has contributed many hours of administrative flights.

The UH-1B and O-1 also have been employed to a great extent in the administrative role. Now these aircraft may soon receive a well earned rest, with the exception of the UH-1B which will be returned to its primary role as an aerial gun platform. Now being received are the newer UH-1Ds to replace a number of the CH-34s. Additionally, with the increase in use of the UH-1D in the command and control role, a number of U-6 aircraft will be retired.

Concurrent with the introduction of the UH-1Ds, most O-1s are being phased out of the inventory and being replaced by the "S" model OH-13. Changes do not stop with the OH-13s. A further development is introduction of the OH-58s.

In the foreseeable future aviation in Europe should continue to gain newer types of aircraft as production increases and redistribution of some Vietnam assets takes place. The recent announcement of the deployment of CH-47 assets to Europe should solve the problem of replacing the aging CH-37 medium lift helicopters. With this addition, modernization of actual flying assets of Europe will be well on the way to completion.

With the influx of new aircraft what will Army aviation in Europe have in the way of aerial armament? Present systems available are XM-3 2.75-inch rocket systems and M-6 machinegun systems, both mounted on UH-1Bs. With the increase in newer aircraft there should be an input of newer weapons systems such as the M-5 40 mm grenade launchers and M-21 combination machinegun-rocket launcher system. Upon arrival in Europe these systems will enhance performance of aerial gunnery. Another weapons system which should prove highly effective is the M-27E1 machinegun mounted on OH-58s in a manner similar to machineguns mounted on OH-6s in use in Vietnam.

So far much has been said about personnel and airborne equipment available to the Army in Europe, but there is one area critical to performance of both—ground support to the aviator while he is airborne in performance of his mission. The Army in Europe has established one of the finest systems of aviator ground support in the world. Air traffic control in USAREUR and flight following are both excellent. The Army Flight Operations Facility (AFOF) of the 15th Combat Aviation Group provides each aviator in USAREUR with necessary information and facilities for filing a flight plan. Primary functions of AFOF are to provide flight planning information including NOTAMs and weather briefings for aviators in locations where they are not available, provide clearance authority for flights from airfields having no clearance officer, and to receive and flight follow VFR flight plans filed by Army aviators in USAREUR.

To augment AFOF the 15th Combat Aviation Group has a tactical flight following element, the 14th Aviation Company (ATC) which provides flight following service to aviators throughout all areas of operations. With flight following centers located in a number of sites throughout USAREUR, the 14th is able to maintain communication with Army aircraft operating throughout most of Germany. In addition to trained flight following personnel of the 14th, USAREUR has a large number of air traffic control personnel assigned to towers at most Army airfields. Each of these controllers is a highly trained specialist in tower and airfield operations.

Other improvements in Army air traffic control in Europe are establishment and certification of increased GCA sites at Army airfields. As with tower operators they must be certified prior to becoming operational. Through arrangement with the Air Force, each GCA facility is checked periodically by the FAA for proficiency of personnel and accuracy of equipment. A further advancement of equipment in use at GCA sites is modification of radar sets to receive Mode 3 (civil) transponder codes for better service to aviators in instrument conditions.

Now back to the young aviator who had just received his wings. His apprehensions are not all dispelled yet, but on his arrival in Europe he will find his original fears are quite outmoded. He will be entering one of the most rapidly advancing geographical areas in Army aviation. Rather than being a stone age bastion of Army aviation, USAREUR is way out in front in thinking and application of newly arriving equipment with much more to come—and soon.

During winter operations USAREUR aircraft frequently encounter heavy snow flurries

DEAR DANNY: TM 55-1520-210-10 for the UH-1D/H, dated May 1969 w/Ch1, states on page 3-8, paragraph 3-30, item 19, ". . . actuate through full range 6,100 to 6,700 plus or minus 100 rpm." My maintenance personnel refer to the dash 20 manual to set the limits of rpm and there is a difference between the two publications. The dash 20 says ". . . check for 6,000 to 6,700 (±50) rpm range." Which of these limits are correct?

LT C.E.G.

Danny's answer: The maintenance manual (dash 20) has the straight poop on engine rpm. The next change to the UH-1D/H Operator's Manual will show "6,000 to 6,700 ±50 rpm."

★ ★ ★

Dear Danny: Yesterday I noticed a circle red X condition in DA Form 2408-13 that restricted my aircraft from IFR flight because the altimeter calibration was overdue. Should the aircraft be restricted from VFR flight, too? Also, what are the limits I should observe when checking the altimeter? Is a 100 foot error acceptable?

MAJ J.G.M.

Danny's answer: In order to comply with FAA regulations for Army aircraft that operate IFR in federal airspace, the aircraft altimeter must have been calibrated within the past 1 year. The same inspection criteria is not applicable to VFR aircraft. To answer your second question, Charlie turned to TM 1-215, Attitude Instrument Flying. Paragraph 2-37a gives this bit of advice: "If the setting (barometric pressure in the Kollsman window) difference exceeds .07 inches Hg. (.07 equals 70 feet altitude) the altimeter is not considered reliable." Sounds like a 100 foot altimeter error is too much.

★ ★ ★

Dear Charlie and Danny: The CH-54A checklist we're using here has no check for fuel flow prior to turning on the ignition during starting. I have word from a friend that the CH-54B dash CL contains this check. If this is true and it is considered a good procedure, why doesn't the "A" dash CL contain this check?

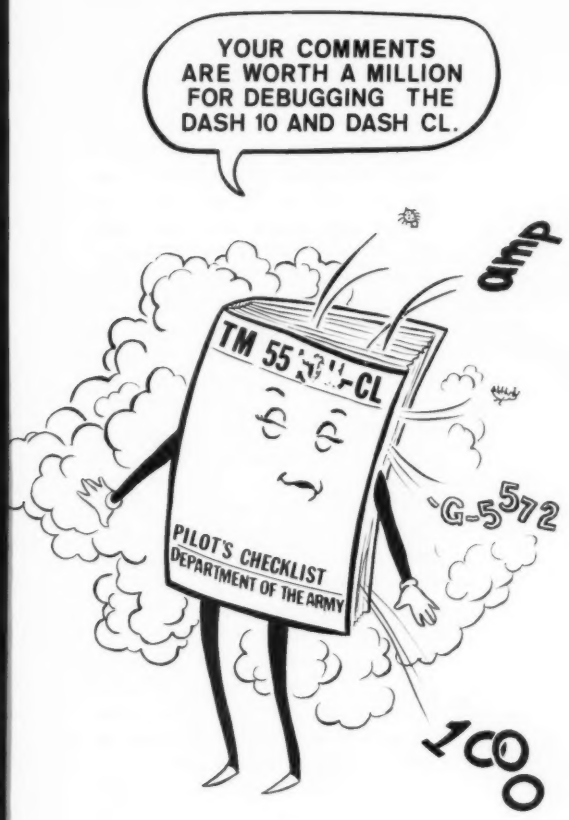
CW3 S.A.

Charlie's answer: The "B" dash CL does contain this check and it will appear in change 5 to the CH-54A Operator's Manual and Checklist.

Charlie and

★ ★ ★

Dear Danny: I just received change 2 to TM 55-1510-209-10/4 (RU-21D Operator's Manual) and on page 2-5 there is a note giving N_1 speed at 100 percent as 38,100 rpm. Figure 7-2 of the same manual indicates that 38,100 is the rpm for



Danny's Write-In

101.5 percent. Which figure is correct for TAKE-OFF power?

CW4 J.H.R.

Danny's answer: First I'll say that you have eyes like an eagle. That's one that even our trusty old proof-reader missed. According to the engine manufacturer, the information given in figure 7-2 is correct. Steps have been taken to correct this discrepancy.

Dear Danny: Change 1 to TM 55-1510-201-10/4 (U-8D Operator's Manual), dated 4 Nov 69, deletes thermal shocking in its entirety and does not indicate any reason for its deletion. There is some concern as to why it was deleted. Can you offer any information on this?

MAJ A.N.W.

Danny's answer: After many inquiries as to why it was reinserted in the original reissue, the procedure was reevaluated. The engine manufacturer's position was that if the engine is operated within established procedures, as referenced in the operator's manual, there is no need to thermal shock and recommend that the practice be discontinued. Based on this recommendation the procedure was deleted from the TM.

★ ★ ★

Dear Danny: Throughout the years I've noted a continual request and requirement by aviation agencies for submission of recommended changes to checklists, technical publications, etc,, by operators and users. Having found myself in a position (standardization and flight training officer) to furnish some of this input data, I meticulously spent many lamplight hours screening the U-8 Operator's Manuals—TM 55-1510-201-10/4 and TM 55-1510-201-10/5—shortly after they were published in February 1969, including everything in my writeup from typographical errors to safety of flight considerations. I submitted my questions, comments and recommendations on a DA Form 2028 and have subsequently received a series of cards, each of which has postponed the expected date of reply to my inquiries. I find it difficult to believe that it should take several months to analyze, come to a decision and reply to inquiries and recommendations concerning a piece of standard Army equipment that has been in service as long as the U-8.

MAJ M.H.W.

Danny's answer: Hang in there, Major. We contacted AVSCOM and were assured that your 2028s are alive and well in St. Louis. Seriously, they are being studied by the Technical Data Cataloguing and Standardization Directorate of AVSCOM. Due to the length and complexity of your recommendations their normal response time had to be extended.

Aeromedic

Provided by the Society of U. S. Army Flight Surgeons

Have you experienced flight above 10,000 feet—15,000—34,000? High altitude flight can produce serious problems such as hypoxia, decompression sickness and a diminishing of night vision sharpness

To the air crewmen: Recently while talking to a group of career warrant officer aviators, it was found that the majority of the group, both rotary wing and fixed wing rated, had experienced flight above 10,000 feet on many occasions. Several pilots related experiences above 15,000 feet with oxygen equipment. The U-21 Ute and OV-1 Mohawk have service ceilings of 27,000 feet and 34,000 feet respectively. At the Aviation School, Ft. Rucker, Ala., the transition courses in these aircraft include oxygen indoctrination flights at or above 21,000 feet. Many of the instructor pilots frequently have flown at 24,000 to 26,000 feet.

What are some of the problems of high altitude flight? First, there is hypoxia (decreased pressure of oxygen at the tissue level with increase in altitude). AR 95-1 states that oxygen will be used in flights above 10,000 feet. Exceptions include *only* those aircraft not normally equipped with oxygen, when higher altitudes are necessary to clear terrain or local weather conditions. This is qualified to state that 14,000 feet will not be exceeded without oxygen and flight between 10,000 and 14,000 feet will not exceed 1 hour—30 minutes of which will not be above 12,000 feet.

Actually those aviators flying aircraft (Ute and Mohawk) normally equipped with oxygen should start using it once they pass through 10,000 feet. During *night* flights, when vision is critical, oxygen should be used above 5,000 feet. Thus, the second important consideration is that of night vision and dark adaptation.

Finally, we must be concerned with decompression sickness. As one goes up in altitude, the pressure decrease creates a tendency for nitrogen bubbles to evolve in the tissues of the body. This usually does not occur until one goes beyond 21,000 feet. Above 30,000

feet, as many as 50 percent will experience decompression sickness after 30 minutes exposure. The conditions commonly noted are bends (pain around joints) and chokes (chest pain, shortness of breath and coughing). Other types of decompression sickness exist, but should be the subject of a full length article. The point to be learned is that flight above 21,000 feet, even with 100 percent oxygen, carries the risk of decompression sickness. The only way to prevent this condition is to prebreath oxygen for 30 to 45 minutes at ground level and up to altitude.

Army aircraft are not usually equipped with oxygen capacities large enough to support preoxygenation procedures (also called denitrogenation), thus the risk exists. Although no Army regulation precludes flight above 21,000 feet with oxygen, it would appear that the safest course of action would be not to fly above 21,000 if it is not necessary.

To the flight surgeon: Much has been said in recent years about stress and fatigue. At present, there are no practical quantitative tests to identify the excessively fatigued air crew member on an individual basis. The only method available is the diligent and knowledgeable subjective appraisal of the individual air crew member by the flight surgeon. In order to accomplish this, the flight surgeon must have personal and close association with the men in his care.

For both acute and chronic skill fatigue, the greatest prevention and treatment is adequate sleep (Z-time). The big questions that arise are, What is real sleep? What interferes with real sleep? There are two types of sleep that are recognized neurologically: rapid-eye-movement (REM) and non-rapid-eye-movement (NREM) sleep. It is apparently the REM sleep that is physiologically and emotionally essential. It is also associated with the dream state, accounting for about 20 to 25 percent of total sleep time.

Alcoholic beverages, even in relatively small amounts, tend to interfere significantly with REM sleep. How does that grab you, elbow benders? In addition, most sleep medications including the barbiturates also significantly interfere with REM sleep. Thus, under these conditions one really isn't getting all the valuable sleep he needs to preclude early acute and chronic skill fatigue.

For those air crew members who have sneaked a peek at this section, do you get the message? Contrary to popular opinion a couple of drinks before hitting the sack doesn't necessarily relax you and make you sleep better. If the ole doc thinks he's being helpful with a periodic sedative, maybe he's not. Certainly, we all need to look at this problem a little more carefully. Let's all think before we act—and get a good night's sleep.

Out Of The Valley Of Death

Major Michael J. Scotti Jr.

There were more than 40 wounded soldiers that needed to be evacuated from the fog-shrouded valley. Major Brady knew this but was unable to find a hole through which he could descend. Finally he could wait no longer and began circling his medevac ship lower and lower—a few meters at a time—through the menacing fog . . .

THE HIEP Duc-Que Son Valley west of Tam Ky in the I Corps area of Vietnam was an unpleasant duty station during January 1968. The facilities were uncomfortable, the weather wet and surprisingly cold and the terrain difficult. To make matters worse, well manned and equipped elements of the North Vietnamese Army (NVA) were in the valley.

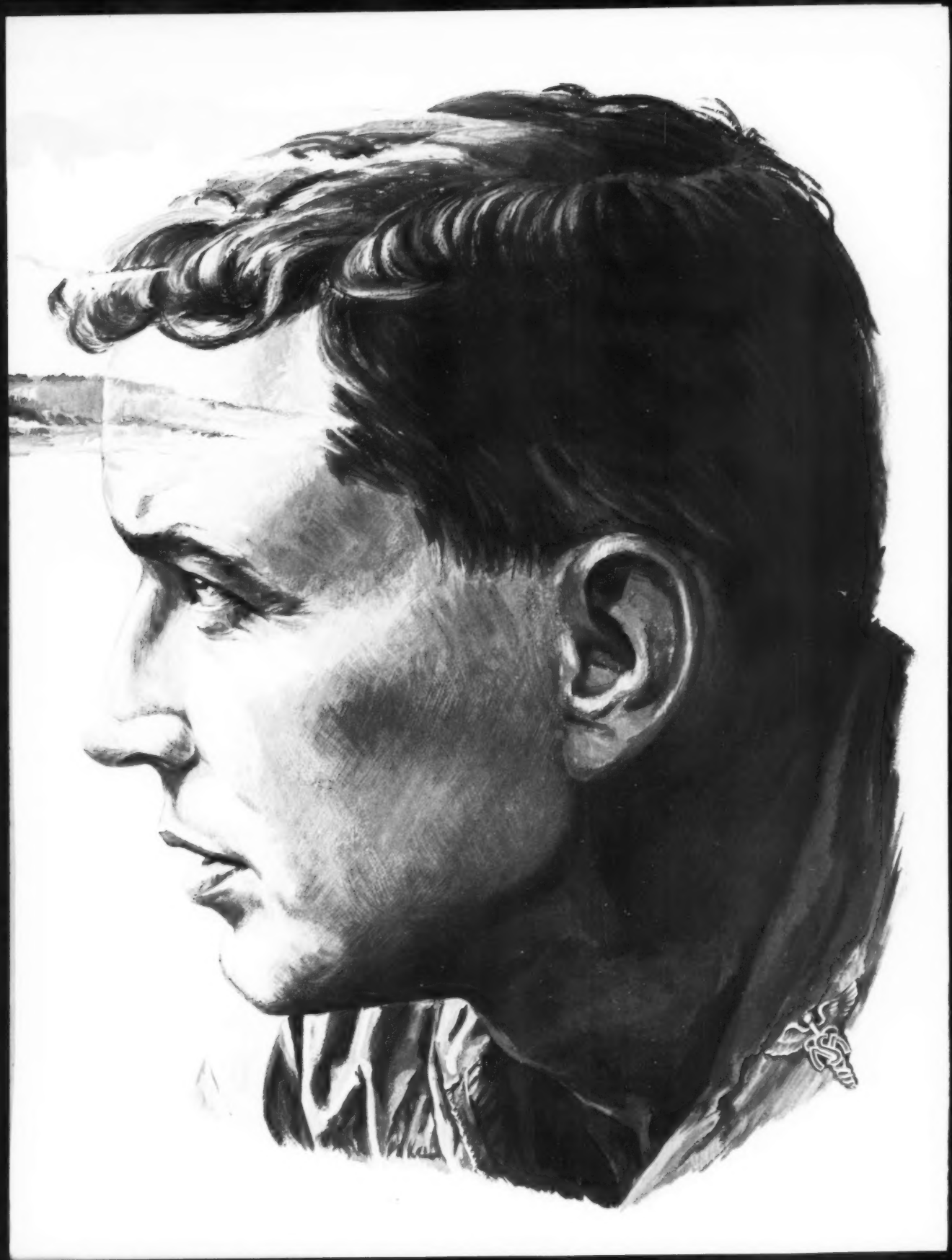
As surgeon for the 4th Battalion, 31st Infantry, 196th Infantry Brigade, I was becoming more and more concerned about the adverse effect the weather was having on air medical evacuation from the valley below Fire Support Base West where our headquarters was located.

Each morning the dense mist hung over the valley shrouding it from sight. Our command and control helicopter, as well as the resupply ships, were unable to get into the valley until late morning when visibility improved.

Shortly after dark on 5 January, an infantry company under the operational control of our battalion was engaged by a larger force of NVA. How large will probably never be exactly determined, but from the information of those surviving the fire power was estimated at battalion strength. Casualties from small arms and mortars began to mount and the besieged company's perimeter became smaller and smaller throughout the night. There was some relief when Alpha Company of the 4/31 performed a miraculous forced march in the wet darkness and shortly before midnight reinforced the beleaguered company.

By 0300 hours it was apparent that a major medical problem existed. My field medics reported they had treated over 40 wounded and counted several known dead with a score more missing or separated from the small enclave established near a dirt farm road. Medical supplies, including the life-saving albumen and dextran intravenous fluid, were almost exhausted and several medics had been wounded while aiding casualties.

Lieutenant Colonel Bill Augerson, our division surgeon, arrived before dawn with additional sup-



plies so that we could set up an enlarged emergency treatment center at the fire support base. We reasoned that because of the weather and enemy fire, the time allotted us for evaluation might well be minimal. In light of this we felt the 10-minute round trip from the valley up to our battalion aid station might enable us to evacuate more than we could if we flew directly to the clearing company—a 50-minute trip. And, at the battalion station we could select those wounded who would profit most by the earliest evacuation to other medical facilities.

By dawn, we were ready. Two medevac helicopters from Major Pat Brady's unit were at the fire support base and the necessary supplies were loaded. Our readiness was checked by the dense fog with tops 400 meters over the valley floor. Things were further complicated by the fact that the embattled troops couldn't see any landmarks to give MAJ Brady exact location, had no flares left to mark the area, limited smoke (two purple grenades, if I remember rightly) and the enemy attack continued although abated.

The troops in the valley had cleared an area large enough for a UH-1 to put down (if you were damned careful) and were waiting —uncomplaining and heroic—as only infantrymen can wait when they have wounded buddies to evacuate and a precarious minimum of ammunition. They understood that the lives of a medevac crew lost in a crash would not help anyone and it was obvious to all that flight conditions were impossible.

Several times that morning MAJ Brady had taken off but was unable to find a hole in the fog and thus was forced to return and wait again. But by 0930 he could wait no longer. He took off over the valley and began circling lower and lower, a few meters at a time until he could hazely see the tree tops a few feet below.

Then he searched for the narrow farm road, hesitating every few meters to turn his craft sideways to enable the rotors to clear a small area of visibility ahead of the heavily loaded aircraft.

Finally locating the road, he navigated along it in constant radio contact with the ground unit which would have to guide him to its exact location by the sound of his aircraft. From the rear of the craft, I could barely see the ground and the stunted trees seemed to appear from nowhere, sometimes barely an arm's length from the tips of our rotor blades. Sporadic rifle fire became more audible and Vietnamese "farmers" could be seen on the road below walking with hoe in hand away from the fray.

Suddenly we were advised that we had passed the ground unit's location so MAJ Brady had to turn around and travel back over the road. Finally to our left we made out a mist of purple in the gray fog. MAJ Brady and his crew had found their wounded.

After unloading supplies and loading wounded simultaneously, MAJ Brady lifted out the first load of six litter wounded. Some were near death and we worked to enable them to survive even the short trip to the fire support base. The flares MAJ Brady brought enabled his sister medevac ship and the command chopper to follow somewhat more easily than he, but still with great difficulty.

Each ship made several trips over the next half hour and some 51 wounded were evacuated, first up to the fire support base for emergency treatment and then to better equipped medical facilities.

Personally, I examined six men who were already in shock when we arrived and who would not have lived without intravenous fluids that morning. There may have been more whose bandages, applied in the dark and at great risk the night before, sealed the exact nature of their injuries from my eyes.

I learned later that MAJ Brady had a busy day that January 6th, and it was for that series of actions that he was awarded the Medal of Honor. These actions are typical of MAJ Brady and the Dustoff pilots and crews which I had the privilege to serve with and observe during my year with the infantry in Vietnam. Their days were busy and each mission, despite the dangers that remained vivid in the minds of other men who participated, were quickly forgotten by the medevac crews in the need to go elsewhere and for yet another task. Their heroism is seen and understood by few other than the fighting men with whom they serve. They are given only a fraction of the honor they deserve.

The readiness of MAJ Brady and the many others like him who do more than is expected to evacuate the sick and wounded is clearly evident, and perhaps is a morale value higher than any other factor enabling the Army to fulfill its mission in Vietnam.

KUM

VIEWS FROM READERS

Sir:

In the February 1970 issue of the U. S. ARMY AVIATION DIGEST there is an article entitled "Lack of Lubrication at What Echelon?" On page 49 there is mention of the fact that the aircraft was flown on a circle red X status. According to the board findings the pilot erred in that he took passengers and planned for more than a one-time flight. The article does not say what the circle red X write-up on the 2408-13 was or whether the aircraft was actually cleared for only a one-time flight.

My question is this: Was the accident investigation board acting under the assumption that a circle red X is for a one-time flight only? Paragraph 4-2 of TM 38-750 defines a circle red X as indicating a deficiency; however, the equipment may be operated under specific limitations. There is no mention of the aircraft being restricted to a one-time flight or from carrying passengers.

Further, it states that when a circle red X is used as the status for a one-time flight it is because a red X has been downgraded in order to fly the aircraft to a higher level maintenance activity only.

Possibly there is some confusion either among the accident investigation board or myself as to the correct definition and usage of the circle red X status symbol. Would you clarify some of these points for us.

SP6 William N. Brabham
90th Avn Co (ASH)
APO Seattle 98749

• The above letter was referred to the U. S. Army Board for Aviation Accident Research for comment since that agency originated the article concerned. USABAAR's comments are as follows: Review of the accident report does not indicate the accident investigation board assumed that a circle red X symbol is for a one-time flight only. The aircraft maintenance records reveal the aircraft was on a red X symbol for "hanger bearing bracket due inspection." This write-up in no way was related to the tail rotor quill, the part which actually failed. The write-up for inspection of the bracket should most likely have been a red dash (—), however, it was carried on a red X and downgraded to a circle red X for a one-time flight to a maintenance unit where the inspection could be performed. The pilot did err because he planned to land prior to reaching his final destination, making it more than a one-time flight.

Sir:

I am writing reference the article about UH-1H slingloads in the January issue. As a CH-47 rated aviator, I must admit that I enjoy carrying slingloads (with a CH-47). However, I would like to point out some areas for consideration in carrying slingloads with a UH-1H.

If your PZs and LZs permit a normal takeoff and landing, your internal load capability would be about 1,000 pounds more than with a slingload. The chances are, with this internal load, you could maintain an airspeed of 90 knots without straining the aircraft. Depending on the type of slingload, about the best you could do safely with a slingload would be about 70 knots. It would be considerably less with some types of loads. With a short haul (say 10 minutes or less) this airspeed difference wouldn't be important.

We found slingloads to be a disadvantage in marginal weather over contested terrain, even with the CH-47s. The reduced airspeed required with a slingload is bad news in low level flight. You can't effectively contour as you can't get low enough. I don't believe one could carry a slingload IFR with a UH-1. Also, we made some approaches (with internal loads) where the mountaintop LZ was completely socked in and we put the nose of the aircraft on the treetops and hovered up the last few hundred feet. Then we would make an instrument departure to VFR conditions. This procedure wouldn't be possible with a slingload.

There is a longer time of exposure in the "dead man" zone on takeoff and landing with slingloads with the UH-1s because of lower airspeeds.

There will almost always be a greater FOD problem with slingloads. Also, the entire tail rotor/tail boom assembly of the UH-1 will show increased wear due to prolonged hovering out of ground effect. This has been noted during rappelling missions.

UH-1 slingloading can be used effectively in RVN in some situations, depending on weather, LZs, PZs, length of haul and type of load. I don't believe it would be practical to fly slingloads with the UH-1H in most situations in RVN.

CW3 Carl L. Hess
HHC, 55th Avn Bn
Ft. Hood, Tex. 76544

The U. S. Army Transportation School, Ft. Eustis, Va., has requested that the DIGEST *print the following:* **Graduates of the Aircraft Maintenance Officer Course, Phase II (UH-1 Maintenance Test Pilot Course) are asked to forward their current addresses for issue of the newly published AH-1G HueyCobra Maintenance Test Flight Handbook to—**

Maintenance Test Flight School (Single Engine)
Aviation Maintenance Training Department
U. S. Army Transportation School
Ft. Eustis, Va. 23604

11th Aviation Group...

Colonel J. Elmore Swenson

Colonel Swenson is the Chief of Staff of the U. S. Army Aviation Systems Command in St. Louis, Mo. He is well acquainted with the aviation group concept—having commanded the 10th Aviation Group at Ft. Benning, Ga., in the early 1960s and later the 11th Aviation Group of the 1st Cavalry Division (Airmobile) in the Republic of Vietnam

A LOT HAS HAPPENED to the 11th Aviation Group since it was organized in the spring of 1963 as part of the 11th Air Assault Division (T). After numerous field tests, it was transferred with the rest of the 11th in July 1965 to the 1st Cavalry Division (Airmobile) and deployed to the Republic of Vietnam shortly thereafter.

The aviation group concept in the airmobile division has done exceedingly well since its inception. Containing over half of the 1st Cav's aviators and aircraft, the 11th Group provides the bulk of the division's airmobile capability, either with its organic assault helicopter battalions or the assault support helicopter battalion. However, a few changes in operations have occurred during the past 3 years.

True, the 11th Aviation Group still supports the division in a manner similar to the division artillery support plan. In the past, direct support of the brigades was provided by the two UH-1 Huey battalions and general support by the CH-47 Chinook battalion, but the original operational concept has been slightly modified.

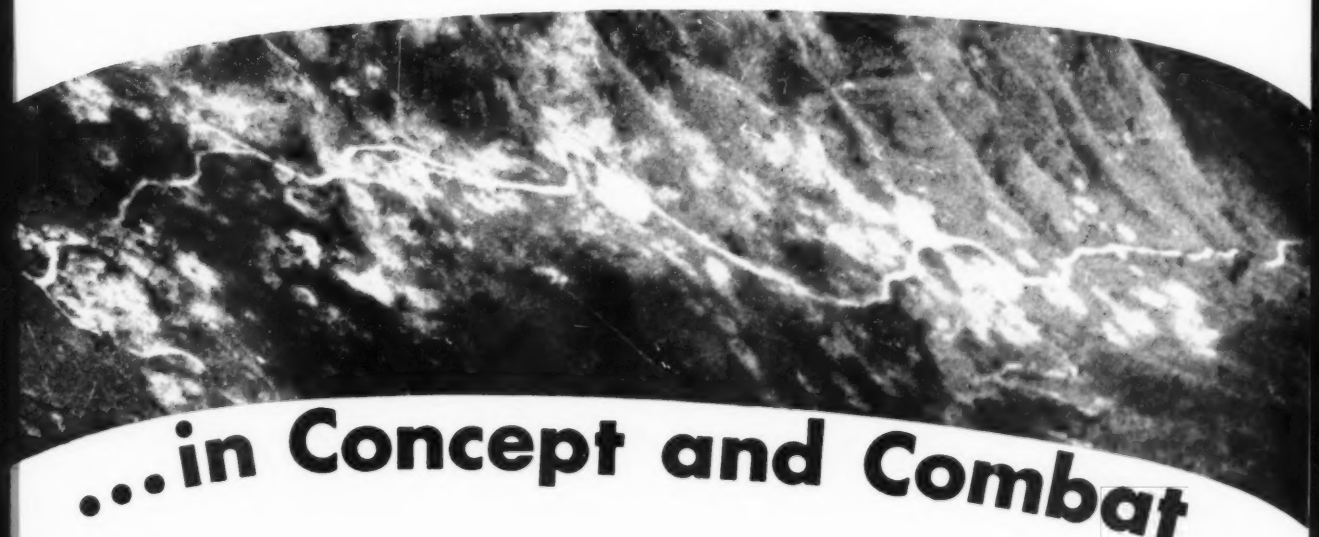
The original "modus operandi" of the 1st Cav conceived that only two brigades would be deployed at one time. The other would remain at a base camp, and the two lift battalions would support each brigade in the field. Currently, all three brigades are continually committed and the group is unable to support a specific brigade with the same lift battalion in direct support at all times. Thus, for the most part, the 227th Aviation Battalion supports the 3rd Infantry Brigade; the 229th Aviation Battalion supports the 1st Brigade; and both battalions share in the support of the 2nd Brigade.

Of course, the obvious advantage of having the same battalions continually supporting the same brigades lies in personnel getting to know each other—their methods and their idiosyncrasies. Also, there are occasions when the division is required to send a brigade task force somewhere out of its area of operation, and the group is required to send a proportionate share of aviation assets along with the task force. Even in the Saigon special "mini" Tet operations last winter this organization for combat held true. This habitual support has provided a flexible response capability which is absolutely essential in air cavalry operations.

Assault Helicopter Battalions: Troop lift is accomplished almost entirely by the group's two assault helicopter battalions (AHB). Each battalion has three companies of 20 UH-1H helicopters plus an aerial weapons company. Both weapons companies have their full complement of 12 AH-1G HueyCobras. The HueyCobras have a mixed armament that consists of XM-157 or XM-159 rockets, or XM-18 gun pods and the XM-28 (minigun and 40 mm in the chin turret). This gives the HueyCobra a capability of carrying either as many as 76 2.75-inch FFAR rockets (with 10- or 17-pound warheads) and 4,000 rounds of 7.62 mm ammunition plus 300 40 mm rounds, or else 7,000 rounds of 7.62 mm ammo and 38 rockets.

The aircraft in each battalion are able to operate for 1½ hours without refueling. The refueling operation, normally accomplished with the engines running to provide rapid turn-around on missions, takes about 5 minutes.

In Vietnam the operating areas of the battalions have and still remain practically unlimited and at times extensive. In 1967 one company of troop helicopters (slicks) and one gun platoon of the 227th AHB operated in the Phan Thiet area while the remainder of the battalion and the



...in Concept and Combat

The 11th Aviation Group participated in the A Shau Valley campaign as part of the 1st Cavalry Division (Airmobile). Above left, a CH-47 Chinook performs a critical resupply mission during the initial phases of the campaign. Above, an aerial view of the ground route leading into the A Shau Valley north of LZ Tiger. At left, a UH-1 Huey unloads troops in tall grass

Low ceilings and high cloud tops make the initial assault into the A Shau Valley (above) a challenge to Army aviators making the long descent through the clouds

229th AHB supported operations in Binh Dinh, Kontum and Quang Ngai provinces. Starting in October the 227th operated out of Chu Lai while the 229th worked in the Bong Song Plains area.

In January 1968 the 1st Cav Div (−) displaced north into the I Corps sector in Quang Tri and Thua Thien provinces to meet the increasing NVA (North Vietnamese Army) pressure. This move was only partially completed when the Tet offensive began. The greater part of the 11th Group was operational in support of the division (−) augmented with a brigade of the 101st Airborne Division. The mission of supporting four brigades (the 2nd Brigade of the Cav remained in Binh Dinh) really taxed the resources of the group. Despite adverse weather conditions and shortages of fuel and maintenance, the outstanding support by the group enabled the division to prevent the attempted seizure of Quang Tri and accomplish the successful relief of Hue.

Combat assaults, logistical resupply and command and control are examples of routine battalion missions. On a combat assault each battalion can fully lift the combat elements of one infantry battalion. Also, the aviation battalion is sufficiently flexible to change, partially or completely, its operational plan after becoming airborne. This capability was demonstrated when two assault helicopter battalions air lifted two infantry battalions into the A Shau Valley during the initial assault.

A variety of other missions may be performed by battalion aircraft. These include psychological operations, nontoxic agent delivery for defoliation and insect control, courier duties, VIP missions, long range reconnaissance patrol insertion and extraction, medical evacuation, slick escort, night illumination, logistical resupply and various types of aviator training missions. Armed helicopters support their respective battalion's troop-cargo carrying UH-1H aircraft whenever gunship escort is required.

Combat assault, logistical resupply (LOG) and command and control (C&C) missions are conducted on a daily basis for the three infantry brigades by the two assault helicopter battalions. Each evening missions for the next day are passed to the 11th Aviation Group by liaison teams attached to each brigade. Group then assigns these missions, based on aircraft availability, to the two helicopter battalions. The missions are distributed to the respective companies by the battalion operations section and are performed the following day. Combat assaults are usually conducted using 6 UH-1Hs to move platoon and company size elements and 2 AH-1G Huey-Cobra gunships for escort. Larger size moves may require as many as 20 UH-1Hs and 6 gunships.

The flight leader of the slicks conducts assigned combat assaults from a mission type briefing. This normally includes a mission number, number of aircraft and sorties required to complete the mission, pickup zone time, location and contact, landing zone location and contact, location of command and control elements and artillery and aerial rocket artillery preparation of the landing zone site. Only on the larger size moves is prior visual reconnaissance performed by the flight leader.

As soon as one mission is completed the aircraft may move into another assault with another battalion of infantry and, before the day is over, the flight may well

have completed 8 or 10 combat assaults in as many landing zones. The assault helicopter battalions are able to conduct these missions rapidly and efficiently because all personnel involved are thoroughly familiar with each other's methods of operation. The experience that developed this excellent familiarity has enabled the infantry battalion to obtain maximum use of the helicopter's airmobile attributes and thereby seek out and destroy the enemy in larger areas of terrain.

Although weather may sometimes hamper mission accomplishment, the helicopter battalions have demonstrated the ability to complete assigned missions under almost impossible conditions. During the Tet offensive both battalions conducted combat assaults, LOG, C&C and emergency resupply missions with ceilings frequently as low as 50 feet and visibility less than ½ mile. Fog and rain were prevalent for the Tet period; a constant rain and haze for 29 consecutive days did not deter the units from completing their missions. It was due to the outstanding ability and courage of the aviators who flew in this weather that the infantry was able to defeat the enemy in northern I Corps during the Tet offensive.

The assault helicopter battalions operate out of secure base camps. Perimeter defensive fires against enemy ground attacks occasionally have been provided by the battalion's armed helicopters. Each battalion provides personnel to augment the infantry units in their mission of perimeter defense. They also provide aircraft on a nightly 10-minute standby basis for illumination, emergency resupply, medevac and armed helicopter escort and fire support for the defense of the base camp and/or infantry units in the field.

Assault Support Helicopter Battalion: The 228th Assault Support Helicopter Battalion (ASHB) consists of three identical companies with 16 CH-47s, an attached CH-54 company with 9 Flying Cranes and a headquarters and headquarters company (HHC). The HHC is authorized 3 OH-6As, but experience has shown that 1 UH-1H and 2 OH-6As provide a more practical mix for liaison, command and control and critical parts distribution. Each CH-47 is equipped with 2 M-24 (7.62 mm) machineguns. The Flying Cranes are not equipped with armament.

The ASHB is employed in general support of the division. The primary tasks assigned to the CH-47s in the battalion are aircraft recovery, moving artillery, combat assault, troop lift, administrative moves in the division area of operations and general logistic moves of all classes of supply to division units. The battalion also is used to move refugees and POWs and augments the support command in the medical evacuation role. The CH-54 is used primarily for heavy lifts such as engineer equipment, howitzers, multiple sling logistic hauls and heavy aircraft recovery. The installation of a passenger pod provides the CH-54 with the addi-

Signal Hill (below) lends proof that landing zones can be small and require great pilot skill

With the crash of one of the lead aircraft, the flexibility of air crew leadership was tested

tional capability for passenger lift or medical evacuation.

One CH-47 can lift 33 combat equipped troops in seats. Combat loaded, this number can be increased to 44 in the "A" model Chinook and 50 in the "B" model if seats and belts are not used. The Chinook also can be used for paradrops, troop ladder operations and close support drops. Although the Chinook is frequently used in combat assaults, it is never used in an initial assault since its size, approach speed and vulnerability makes it unsuitable.

The Chinook is the key to movement of the division's organic 105 mm howitzers. Normally it takes 13 CH-47 sorties to move an artillery battery. The 105s are carried externally with "piggyback" slingloads; e.g., one howitzer with a sling of ammunition attached. External slingloading is the most effective method of using the Chinook. Internal loads are more time consuming due to loading, tie down and unloading requirements.

The best method of employing an ASHB is by selective use of the entire battalion's assets. The previous doctrine of employing companies with a brigade proved to be highly detrimental to the battalion maintenance effort. Centralized control of missions with decentralized company locations was found to be the most efficient and effective method for ASHB utilization.

11th General Support Aviation Company: The mission of the 11th General Support Aviation Company is to furnish aviation support for the division headquarters, 11th Combat Aviation Group headquarters, support command and other units within the division without organic aircraft, and to provide radio relay capabilities to extend the division's communication system.

The 11th General Support Aviation Company is responsible for providing observation, reconnaissance and surveillance, aerial command posts and relay stations, VIP and staff liaison flights and emergency aeromedical evacuation. The general support company also is responsible to provide aircraft for the use of assigned aviators to meet annual flying requirements. It further maintains flight records for the division and 11th Combat Aviation Group headquarters.

To accomplish its assigned mission, the 11th General Support Aviation Company currently has three types of aircraft on its TOE. These aircraft are organized in three platoons: the utility platoon with 10 UH-1Hs; the support platoon with 10 OH-6As; and the aerial surveillance and target acquisition platoon with 6 OV-1s.

The utility platoon supports the division and group commander and staff, and those division units lacking organic aviation. To accomplish its mission, a system of "sole user aircraft" is used. This system assigns specific aircraft to the division commander, both assistant division commanders, the chief of staff and G-2 and G-3, the group commander, the Eighth Engineer Battalion commander and one command standby aircraft. The remaining 2 UH-1H helicopters are assigned to other units on a mission basis.

The support platoon supports all other units in the division and occasionally supports other units working in their area of operations. Examples of their missions are convoy cover, reconnaissance and surveillance, transportation for liaison officers between supporting units and psychological warfare missions.

The ASTA platoon provides the division with its "eyes." It performs

aerial observation, reconnaissance and surveillance by visual, radar, infrared and photographic means of enemy areas for the purpose of locating, verifying and evaluating targets, terrain study and fire adjustment.

Communications: The vital link in airmobile operations is communications. Since success or failure depends on the ability to communicate, the air cavalry division must depend on the radios used by its aerial relay and command post aircraft. Although these aircraft already have organic radios (one UHF and one FM) it is necessary to acquire additional FM capabilities and a single side band (HF) to provide the required command post communications.

The AN/ARC-122 FM communications packet (developed by the group and fabricated by Lexington Depot) provides the needed additional capability. Each packet consists of two RT-524 radios plus necessary controls and antennas. The system is wired into the aircraft intercom system and can be installed in less than an hour by trained personnel. Where required, two systems may be interconnected to provide a total of four FM channels.

The RT-524 is the basic radio used in the VRC-12 series of vehicular mounted ground radios. It was selected for use in the ARC-122 because it can operate on all current FM channels, is readily available in the division and has a considerably higher power output than the ARC-44 (35 watts as opposed to 9 watts).

The group also has five lightweight ground controlled approach (GCA) units. These units (AN/TSQ-71) also were fabricated by the Lexington Depot. Although they may be moved on ¾-ton trucks and trailers, more rapid displacement can be accomplished when CH-47 helicopters are used. Using either mode of movement, the GCA unit can occupy a position and become operational in 40 minutes.

While an excellent communication system exists in the group, it would be of little value without effective radio procedures. To help assure this the division made use of a technique and procedures handbook which standardized and coded proven tactics and aircraft loads. Each aviator must be thoroughly familiar with the contents of this book.

Future Considerations: In 1963 senior officers establishing the 11th Air Assault Division (T) emphasized that division airmobile concepts were sound, but that success would only result from unparalleled proficiency, initiative and dedication on the part of assigned personnel. The officers and men who fashioned the 11th Aviation Group were well qualified in these traits, and the seeds they have sown are bearing the fruits of victory in Vietnam.

U. S. Air Force C-130 transports (below) play a vital role in airmobile warfare by flying resupply missions and increasing helicopter availability for combat operations

Trucks provide invaluable support to airmobile operations. Above, 1st Cavalry Division vehicles stop for the night at Landing Zone Stallion during the A Shau campaign

Notwithstanding, apparent improvements still must be sought to enhance group aviation operations, principally in all-weather capabilities and logistical support. Although the Khe Sanh battle was a classic for the 1st Cavalry Division, it was the A Shau Valley campaign which must serve as a war gaming vehicle for future studies of the aviation group. As to logistical support, the 500-mile move of the 1st Cav in October from I Corps to the III Corps area and immediate subsequent operations must serve as a study vehicle to improve aircraft logistical support in future operations, especially in possible high- and mid-intensity war areas such as Western Europe and the Middle East.

The A Shau Valley campaign brought forth the critical factor of weather which has its impact on operations. Still to be attained is an all-weather flying and maintenance capability. Weather remains the "Achilles' heel" of Army aviation.

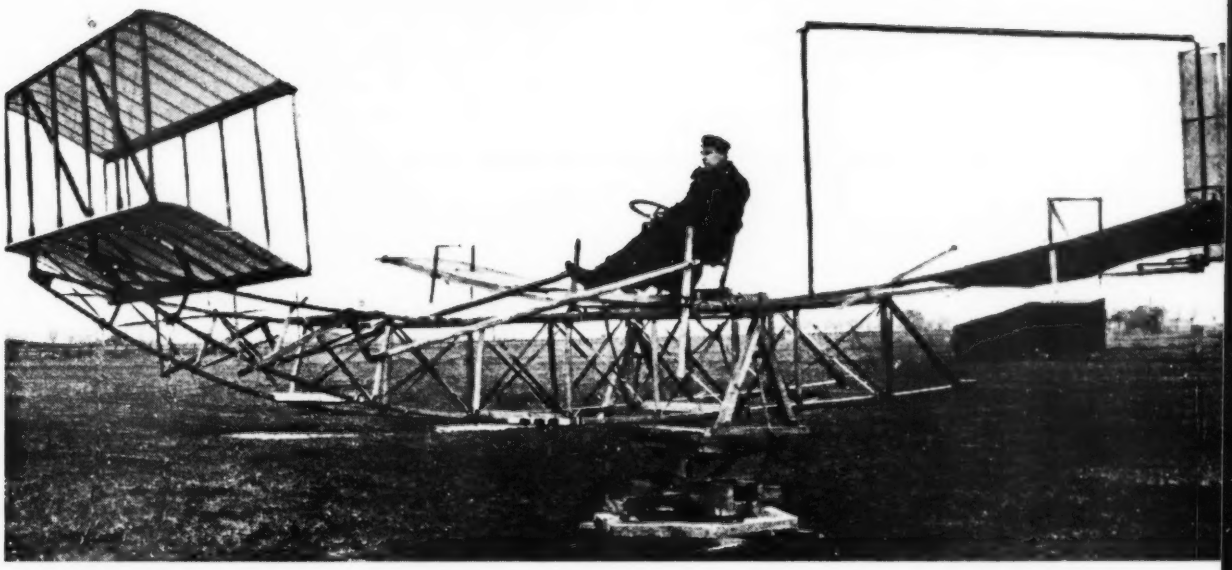
The weather factor can be nailed down to one specific type of weather: low stratus. Of course, trade offs with other Army equipment could be made if this weakness could be solved. On the other hand, groundmobility also can come to a screeching halt in weather—not so much because of low stratus, but rather heavy rain, sleet, snow and ice. So, despite the fact that we do not have all-weather groundmobility, the Army wants an all-weather airmobility before seriously negotiating for trade offs.

In the A Shau Valley campaign it was really the inability, particularly at night, to get through the extremely low ceiling which presented the big obstacle. Self-navigation and better instrumentation are required and should be sought to enhance the aviation group operations.

Logistical support to attain readiness becomes a real problem, especially when the aviation group has to make a long move and then immediately enter into sustained combat operations. The lack of an immediate integral tactical air capability to save costly rotor blade time also is something we must consider. The limit of the lines of communication must be considered if we are to fight a high- or mid-intensity war in Western Europe. We must overcome the problems of roles and mission jealousies and substitute for this the cooperative spirit necessary to achieve our desired results.

Whatever the case might be, a new logic in Army combat operations is required. Certainly this should be a prime consideration for the new MASSTER program now crystallizing at Ft. Hood, Tex., under the leadership of Major General John Norton.

Below, a captured Russian 37 mm antiaircraft gun. These weapons posed a serious threat to the 11th Group during A Shau operations



It'll Never Get Off The Ground

It might not get off the ground, but then it isn't meant to. The contraption above is one of the first attempts to construct a flight simulator. Since then considerable improvements have been made in this field. One of the most recent is called the synthetic flight training system (SFTS) which is scheduled to be put into operation at the U.S. Army Aviation School late this year

Major George Coutoumanos

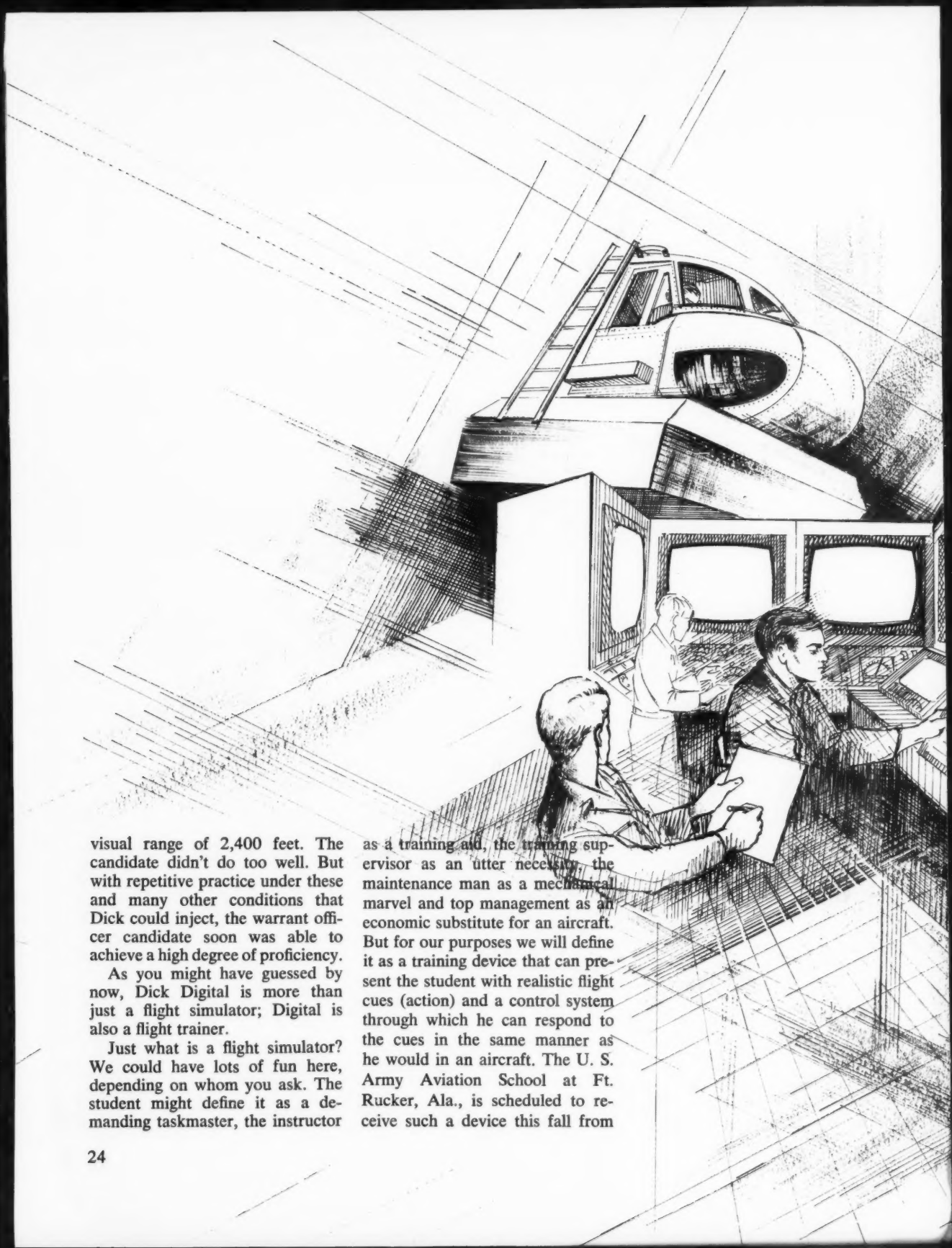
"GOOD MORNING, sir, my name is Dick Digital and I shall be your instructor for the next three periods of instruction. During this first period we will work on UH-1 engine failures. The important thing to remember, sir, is that the altitude and airspeed at which engine failure occurs dictate the action to be taken to effect a safe landing. When you are ready we shall proceed first with an engine failure while hovering."

The young warrant officer candidate settles himself, does a fast scan of the instruments and, feeling a little tickled at being called sir, murmurs to himself, "I'm ready if you are, Dick."

Dick Digital continues, "Take the controls and follow through as I demonstrate the corrective action to take in event of engine failure while at a hover."

Dick Digital demonstrates the maneuver for the WOC, showing him how much collective pitch to hold, how and where to hold right pedal and how to maintain position with cyclic control. Dick then turns the controls over and the student tries it.

The candidate does so well that Dick decides to pump a little something extra into the game—he makes it nighttime and injects a 200-foot ceiling with a runway

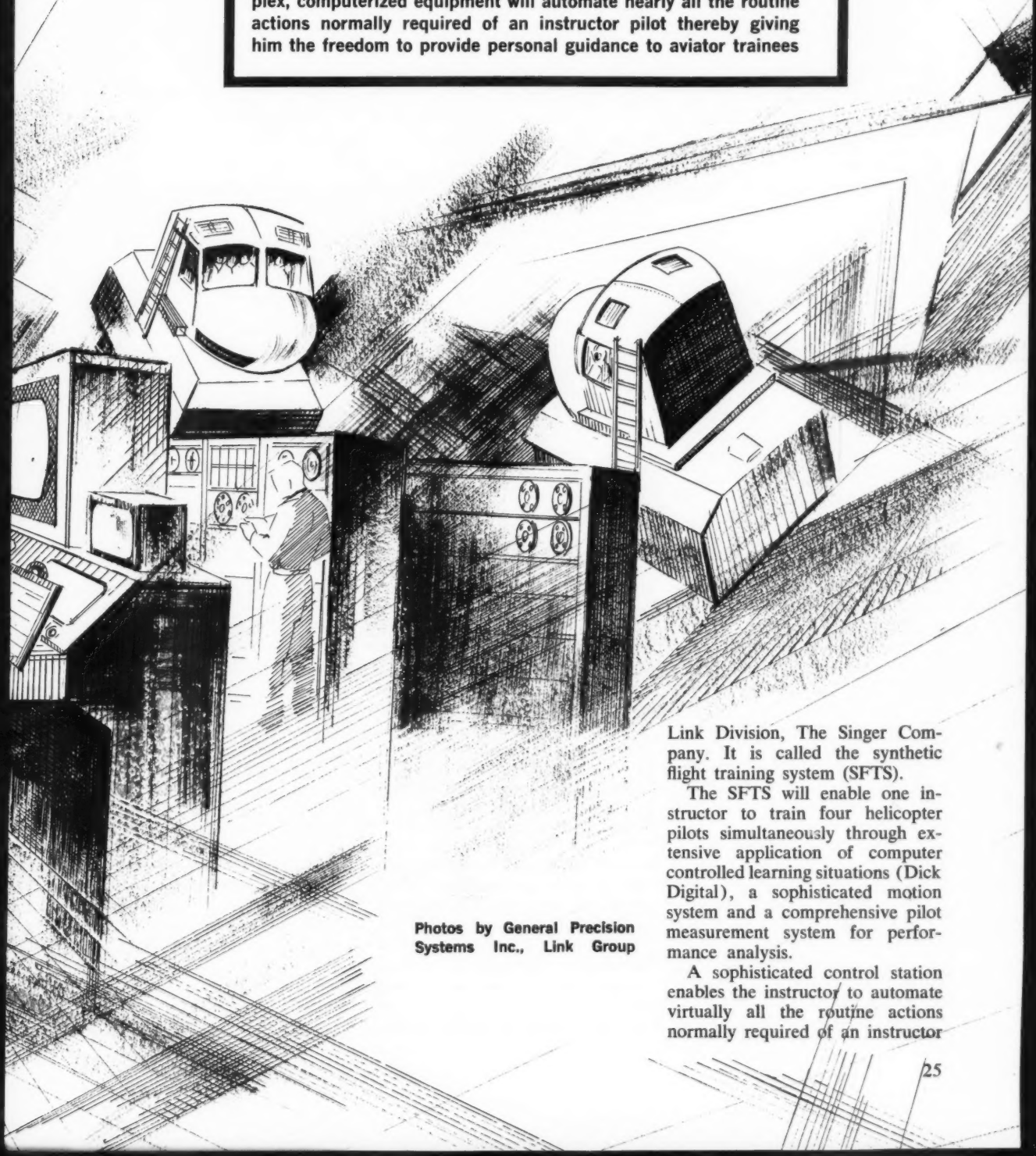


visual range of 2,400 feet. The candidate didn't do too well. But with repetitive practice under these and many other conditions that Dick could inject, the warrant officer candidate soon was able to achieve a high degree of proficiency.

As you might have guessed by now, Dick Digital is more than just a flight simulator; Digital is also a flight trainer.

Just what is a flight simulator? We could have lots of fun here, depending on whom you ask. The student might define it as a demanding taskmaster, the instructor as a training aid, the training supervisor as an utter necessity, the maintenance man as a mechanical marvel and top management as an economic substitute for an aircraft. But for our purposes we will define it as a training device that can present the student with realistic flight cues (action) and a control system through which he can respond to the cues in the same manner as he would in an aircraft. The U. S. Army Aviation School at Ft. Rucker, Ala., is scheduled to receive such a device this fall from

The synthetic flight training system (SFTS) will enable one instructor to train four helicopter pilots simultaneously. This complex, computerized equipment will automate nearly all the routine actions normally required of an instructor pilot thereby giving him the freedom to provide personal guidance to aviator trainees



Photos by General Precision Systems Inc., Link Group

Link Division, The Singer Company. It is called the synthetic flight training system (SFTS).

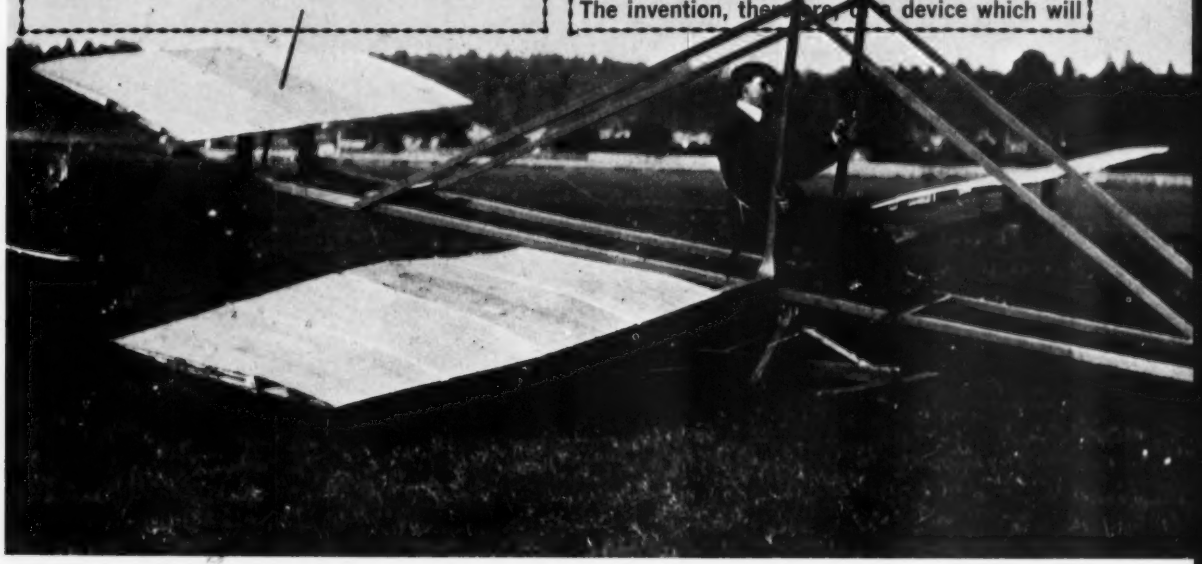
The SFTS will enable one instructor to train four helicopter pilots simultaneously through extensive application of computer controlled learning situations (Dick Digital), a sophisticated motion system and a comprehensive pilot measurement system for performance analysis.

A sophisticated control station enables the instructor to automate virtually all the routine actions normally required of an instructor

Two of the first attempts to simulate flight were the Sanders Teacher (page 23) and the Eardly-Billing Oscillator (below and following page). Here is a description, in part, of the Sanders Teacher taken from the December 10th, 1910, issue of FLIGHT INTERNATIONAL:

"Those wishing to take up aviation either as a recreation or a profession find many drawbacks at the commencement of their undertaking, but one of the most formidable, especially to those not blessed with a long purse, is the risk of smashing the machine while endeavoring to learn how to control and fly it.

Even the most apt pupil is certain to find himself in difficulties at some time or another during his probation, and owing to lack of skill the machine is necessarily sacrificed to save his life, or at least to prevent a serious accident. The invention, therefore, of a device which will



pilot. Freed from the need to manipulate controls and switches, the instructor is able to provide personal help and guidance to aviator trainees, while the automated system provides direction and an objective analysis of the aviator trainees' performances.

The instructor's station will include the following functions and related controls (all can be either fully automated or manually activated):

• A prerecorded library of oral briefings, under the control of the aviator trainee, presenting orientation instruction and a description of the problem to be encountered.

• Prerecorded instructions and computer controlled instrument movement requiring aviator trainee participation.

• Continuous visual recording of aviator trainee performance for immediate or subsequent critique.

• Variability of the training task complexity through mastery of instruments and controls to vary flight parameters, extend or contract environmental factors, insert emergency conditions and alter flight conditions.

• Prerecorded computer controlled oral warnings when the aviator trainee has exceeded predetermined tolerances.

• Prerecorded computer controlled reminders to the aviator trainee when performance parameters of a particular type indicate a repetitive pattern.

• Up to 15 prerecorded air traffic control messages for aviator trainee interpretation and compliance.

• Automated, objective performance measurement that compares the aviator trainee to the ideal and makes possible a comprehensive, statistical and individually applicable analysis of the training mission.

• In the not-too-distant future a film, computer generated or model mockup visual display that is indicative of actual visual flight.

One SFTS subsystem consists of four cockpit modules controlled by digital computers with one instructor station. The aviation school currently is scheduled to receive eight of these subsystems, or a total of 31 UH-1 cockpit modules and one CH-47 cockpit module.

An average training day might go something like this: Prior to the students' arrival, the instructor conducts a morning readiness

enable the novice to obtain a clear conception of the workings of the control of an aeroplane, and of the conditions existent in the air, without any risk personally or otherwise, is to be welcomed without a doubt. Several have already been constructed to this end, and the Sanders Teacher is the latest to enter the field.

The aim and object of an invention of this kind is naturally to render tuition safe to the pupil

check by inserting a tape into the computer.

He then inserts the appropriate computer and audio tape and assigns his four trainees to cockpits.

Each aviator trainee begins the program of instruction by listening to a standardized tape recorded briefing. This is followed by a demonstration during which the computer flies the simulated aircraft through the maneuver just as an experienced instructor pilot would. Appropriate audio commentary on what to observe and do at various times is keyed to the demonstration while the trainee flies the mission. As he does this, the computer measures his performance and makes the maneuver easier or more difficult according to the trainee's progress. The level of difficulty is varied by introducing such factors as turbulence, malfunctions and communications load.

During the aviator trainee's execution of a maneuver, plots are made of ground track for cross-country and approach models as well as any aircraft parameters desired such as airspeed and altitude and a tape recording of air-ground communication is made. These plots are used by the instructor to manage the training problem and can be used for debriefing and critique. Records of trainee performance data in a format suitable for magnetic tape recording will be available for research.

The logical question that comes up now is, How does SFTS accomplish all of this? The answer is by a *high fidelity, computerized, motion system.* To better understand this, we'll have to go back a bit.

Not too many years ago we used to say that a pilot flew his aircraft by the seat of his pants. But now we can describe this phenomenon a bit more scientifically as "the utilization of proprioceptive sensors as an information channel for feedback of an alerting signal in an aircraft control loop." The proprioceptive sensors are located in the muscles, tendons, joints, the nonauditory portion of the middle ear and the pressure sensing mechanisms of the skin and connecting tissues. They sense the forces expected by the muscles, the external forces acting on the body and the orientation of the body to gravity vectors.

The significance of seat-of-the-pants flying in modern times has tended to be downgraded and even ignored. Yet, we cannot deny that an aviator still has to detect, interpret and perhaps respond to things that affect the seat of his pants such as yaw due to unsymmetrical thrust and differential actions; the out-of-trim condition or g forces resulting from a pullout or steep turn; the slip-skip accompanying an uncoordinated turn; vertical accelerations caused by turbulence and the longitudinal accelerations associated with power changes. Further, an aviator must sense and respond to vibrations of either the total airframe or the individual controls . . . sometimes just in his knees when things really get rough.

This is where *high fidelity* comes in. The highly accurate flight simulator is perhaps best exemplified by a simple analogy to the hi-fi system of the music world. It is a well recognized fact that the more natural recorded music can be made to sound, the higher the fidelity is said to be. Likewise, the closer a flight simulator can be made to function like the actual aircraft, the higher the degree of fidelity.

Aircraft motion may be described as taking place within any of 6 degrees of freedom. Three of these are in *rotation* around the axes of pitch, roll and yaw; and three in *translation* along these axes in a longitudinal, lateral or vertical direction. All vibrations,

buffets, jerks, accelerations, decelerations, rates of onset and change occur with respect to, and can be fully described in terms of, one or more of these degrees of freedom of movement. A *high fidelity* flight simulator will have at least pitch, roll and yaw. The SFTS will have pitch, roll, yaw, lateral and vertical displacement. In other words, it will have 5 degrees of motion.

Of special note in the SFTS is that the *lateral displacement* feature, generally speaking, will put the center of gravity in the cockpit like in an actual cockpit rather than underground where it falls in most flight trainers; and *vertical displacement,* the up and down motion characteristic of helicopter flight, will simulate up to a 40-knot wind shear, among other things. During this maneuver the module will rise approximately 2 feet to a total cabin height of 22 feet above ground level.

Computer

The computers of the SFTS are high speed digital computers requiring only a feed-in by tape of any desired program or program change. Here the analogy of the record player in the high fidelity sound system to a modern digital computer in the simulation system is a good one. The SFTS high speed digital computers can be reprogramed in a matter of minutes with a completely new record.

When preparing a digital simulator utilization schedule (tape), it is not necessary to set aside large amounts of time for the purpose of keeping computer hardware current with aircraft changes. The math model of the aircraft, prepared by the manufacturer, can be updated separately, just as a phonograph record is prepared independently of the record player. This is an aid to the fidelity of simulation; thus, the ability to keep the simulator current is important to the overall fidelity of training.

True performance repeatability (the capability to duplicate its programing at a greater speed) is another advantage offered by the digital computer. Since the digital computer does not depend on moving parts or electromechanical comparisons but rather on exact counting techniques, its repeatability is far superior to that of the analog or older type computer. Mechanical reliability, for the same reason, also is improved.

The digital computer consists basically of three components or units:

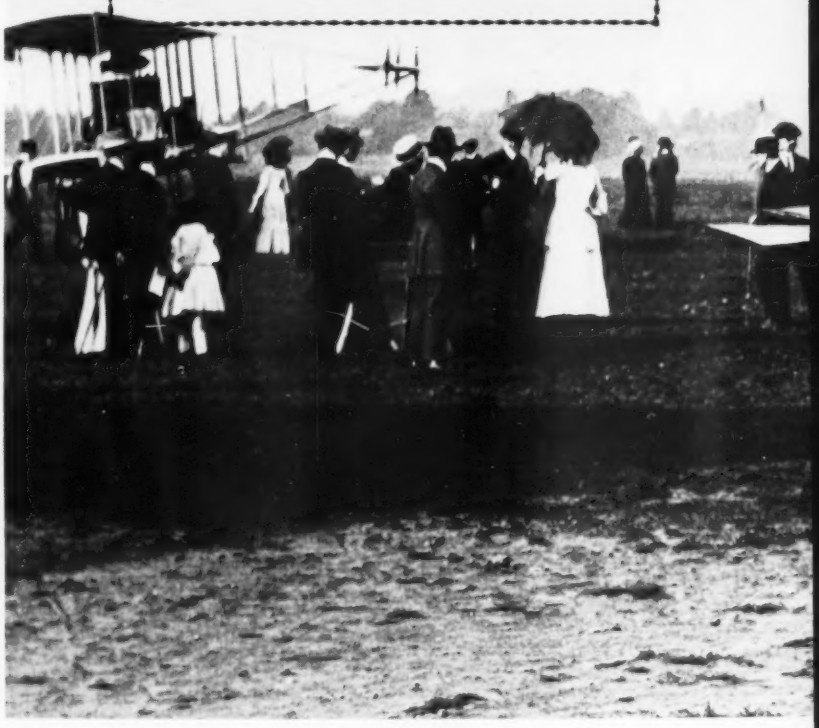
• The memory (the phonograph record) which provides the computer with the ability to store or memorize instructions which comprise solutions to various problems being worked on the computer.

• The mill or arithmetic section (the phonograph turntable and electronics) where the operations called for by the program are performed on the data stored in the computer memory.

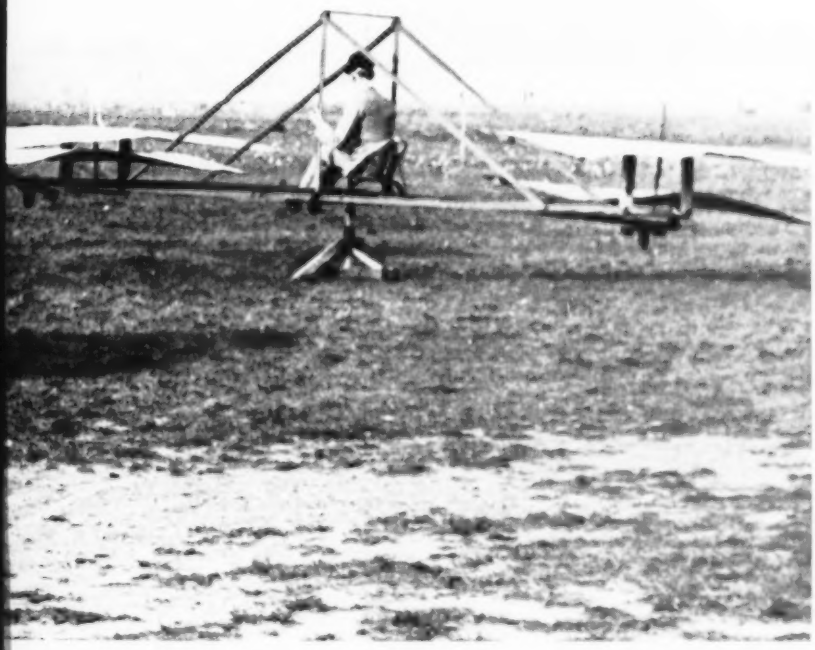
• The input and output channels (the loudspeakers). Various ways are needed to connect the computer memory with the outside world, e.g., converters, typewriters, card reader, etc.

The digital simulation computer

while at the same time giving him confidence. Now there is a tendency to design such an apparatus merely for purposes of balance and without any real resemblance to an actual aeroplane, while the very balance is so exaggerated that the pupil is placed under conditions that are in no way so arduous in free flight.



. . . All these details are standard parts of the Sanders biplane and can be substituted if desired by the same parts of any other type of aeroplane. Thus, the purchaser of a Teacher is buying parts which can be used later if he wishes in the construction of a machine and his outlay can therefore scarcely be considered an extravagant one."



performs only one operation at a time but does it so fast that hundreds of operations are accomplished each second. The computer produces a continuous stream of solutions to the ever-changing flight situation so that simulated indication (movement) completely corresponds to those movements encountered during an actual flight situation.

The SFTS is *modular*. That is, the main systems—the cockpit, computer, motion platform and instructor station—are all independently additive or replaceable. This modular concept provides for versatile growth and change potential.

This then is the *what* (synthetic flight training system), *how* (high fidelity, computerized, motion system), *where* (U. S. Army Aviation School) and *when* (initial installation scheduled to begin this fall) of the SFTS. Now for the biggie: *why*?

Perhaps as good a place as any to start a discussion that is certain to become controversial is to state the ultimate objective and goals being sought, so that the ends justify the means. The tasks of an Army aviator and the responsibilities he assumes can, on occasion, more than tax all the capabilities and unique characteristics that a mere man can bring to the job. The training problem is to make sure that every Army aviator can succeed in his mission under the most negative conditions and the worst possible physical and psychological environments. For it is at this point that professionalism pays off in mission accomplishment —saving lives and protecting equipment. But one does not become a professional by accident, wishful thinking or just through accumulated experience; it is a product of extensive and rigorous training properly oriented toward meaningful objectives.

The aggregate training objectives of the aviation school are to produce an aviator with the proper proportion of skills to meet operational requirements and who is immediately responsive to the demands of the ground commander. The school trained Army aviator then should be capable of participation in both independent and joint actions in support of ground troops under visual and instrument flight conditions.

With this in mind let's return to the big question, Why a synthetic flight training system? Flight training must be accomplished without excessive cost and at the same time continue to improve the existing high standards of aviator proficiency. This can be accomplished by flight simulation. The increased capability and flexibility of the newer flight simulators have led to reductions in flight related attrition among trainees, reductions in time required to meet various flight criteria, improved performance during training and a better qualified aviator.

While flight simulation is by no means the total answer, it is a big step in the right direction—producing a better qualified aviator. Flight simulators can be instrumental in achieving this goal.

Maintenance

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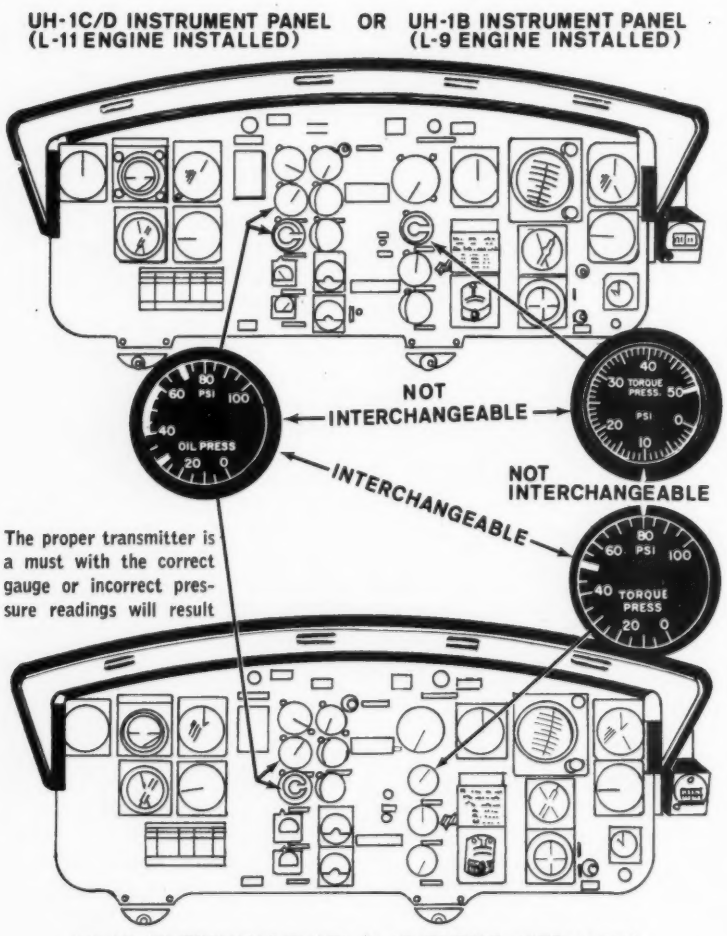

UH-1C/D INSTRUMENT PANEL (L-11 ENGINE INSTALLED)
OR
UH-1B INSTRUMENT PANEL (L-9 ENGINE INSTALLED)
NOT INTERCHANGEABLE
INTERCHANGEABLE
NOT INTERCHANGEABLE
INTERCHANGEABLE
The proper transmitter is a must with the correct gauge or incorrect pressure readings will result
UH-1H INSTRUMENT PANEL (L-13 ENGINE INSTALLED)

Interchangeable Pressure Gauges On UH-1 Aircraft Are Not Always Meant To Be Interchanged: In all UH-1 aircraft the engine oil pressure, transmission oil pressure and torquemeter gauge are interchangeable; however, although they are interchangeable, they cannot be used in all models. The UH-1H (T53, L-13 engine with 0 to 100 pounds per square inch pressure transmitter installed) torquemeter gauge indicates in increments of 1 psi, from 0 to a maximum of 100. Installation of a 50 psi gauge in the torquemeter gauge cavity on the instrument console will give a reading lower (usually 50 percent lower) than actual torque output. The UH-1B and C (T53, L-9 or L-11 engine with 0 to 50 psi pressure transmitter installed) torquemeter gauges indicates in increments of 1 psi, from 0 to 50. Installation of a 100 psi gauge in the UH-1B or C will give a torque reading higher (usually 50 percent higher) than actual torque output.

Erroneous torque readings can lead to gross overconfidence with respect to the aircraft's power potential or, on the other hand, unwarranted restraint in the use of available power, both which can be dangerous. Checking for proper pressure transmitters and gauges

Matters...

pressure gauges

during installation is elementary. Become familiar with the pressure systems and spot check your aircraft for proper gauges and transmitters. The 0 to 100 psi gauge and transmitter should be used on the UH-1H. As is often the case, the simple little incident will cause the complex big accident.

★ ★ ★

Troubleshooting: Try this tip to keep your OH-6A Cayuse in the air. Due to the sensitivity of the systems it is a must to follow the troubleshooting charts as depicted in TM 55-1520-214-20. It will save you time and elbow grease. For example, when you get a high engine oil pressure reading don't lower the pressure by adjusting the regulator valve. This will give you low torquemeter readings. Instead, follow the first step in the troubleshooting chart which states "check out the oil pressure gauge and the sending unit." In all probability the sending unit is transmitting and the pressure gauge is inoperative. Replace this sealed oil pressure gauge and the oil pressure will most likely be in the green.

Bag It: If cleanliness is next to Godliness, baggies should be an unexpected saint in the realm of aviation safety. The small transparent sandwich bags can be placed over the openings of all quick disconnects on the UH-1 series aircraft to prevent dirt and moisture from entering the exposed openings. The bags are cheap to purchase and can easily be attached over the opening of an exposed quick disconnect by use of a single rubber band. They will help to prevent fuel contamination or corrosion of portions of the electrical system. The next time you look for ways in which to make your UH-1 aircraft safe, think small and think cheap. After all, safety is in the bag.

★ ★ ★

Torque: Checking fasteners accurately to determine if they have been tightened to the specified torque value is not possible. A fastener that has been tightened to a specified torque value requires approximately 10 percent more torque than was originally applied to overcome friction and start the fastener turning. When there is doubt as to whether a fastener has been tightened to correct torque value, the fastener should be backed off from one-half to one full turn and retightened to the correct torque value. A torque wrench should not be used for the backoff operation. Every aircraft mechanic should familiarize himself with TM 55-405-6 which covers aircraft maintenance tools.

★ ★ ★

External Loads: TM 55-450-8 (20 May 66) on external transport procedures will clue you on rigging rolling liquid transporters, Conex containers, trucks, 105 howitzers, ammo, etc., you name it. TM 55-450-11 (21 June 68) on helicopter external loads rigged with aerial delivery equipment will give you standardized procedures for rigging "type loads" with slings, clevises, straps and containers. Air delivery means getting there "fastest with the mostest" and proper load rigging plus sling PM is a MUST if supplies are going to reach the ground in one piece. If you came out with the short end of the stick when those slings were passed out, check out SC 1600-IL (11 Aug 67) and place your requisition.

The 1249th Tra

Learns Wh

Lieutenant

THE MEN OF THE 1249th Transportation Company, 111th Aviation Group of the Texas National Guard will spend their yearly 2-week summer encampment at the Gulf Coast facilities of the Army Aeronautical Depot Maintenance Center (ARADMAC) in Corpus Christi, Tex., for the second consecutive year.

Last June the company's 6 officers, 6 warrant officers and 229 enlisted men arrived at the ARADMAC site to begin refresher training in such technical specialties as aircraft supply, electronics, hydraulics, instruments, engines, transmissions, propeller and rotor repair, as well as other supporting fields.

Such technically skilled personnel must get the most realistic training possible in a short 2 weeks each summer in order to maintain their proficiency. Since their normal training site did not provide enough availability of the newer family of Army aircraft to maintain their specialized skills, Colonel Grady M. Roberts, the group commander, decided to try something different.

Why not, he thought, let these men work on the latest Army equipment available and at the same time utilize all this manpower toward a worthwhile goal.

The most likely place that could fit the description was the ARADMAC plant where battle-damaged aircraft straight from the Republic of Vietnam are rebuilt from rotor head to skid toe.

With the help of the 4th U. S. Army and with the cooperation of Colonel Luther G. Jones, ARADMAC commander, preliminary plans for the first National Guard unit to train in ARADMAC facilities took shape.

By evaluating the occupational specialty level of each man in the unit, and considering both his formal schooling and operational training, he was programed for training in ARADMAC at a level at which he could make progress within the 2-week training period.

Within a short time after receiving their assignments the

Above, Major General Ross Ayers (center), Ac
(left) are welcomed to U.S. Army Aeronaut
inspection of the 1249th's activities by depu
tional Guard soldier explains the experienc
sheet metal shop to (left to right) M

Major Raymond Logan (center), commander of the 1249th, is briefed by ARADMAC commander Colonel Luther Jones about his installation's maintenance facilities. Mr. Walter Mertz, ARADMAC coordinator for military training, observes

nsportation Company

hile It Serves

James C. Moore

men were actually involved in the repair of battle-torn aircraft. Each man was integrated into the ARADMAC activity on an on-the-job basis by MOS (military occupational specialty). Initially the student and instructor performed identical functions which allowed the student to not only observe, but also to participate, with the instructor making on-the-spot corrections while continuing his duties.

The officers and warrant officers of the repair shop and avionics platoons and the quality control section were all assigned duties within their specialty to assist in supervision and coordination.

For 2 weeks the men of the 1249th worked at tearing down and rebuilding UH-1 Iroquois and AH-1G HueyCobra engines and transmissions, repairing and balancing rotors, overhauling and testing radios, as well as electrical, hydraulic and instrument components.

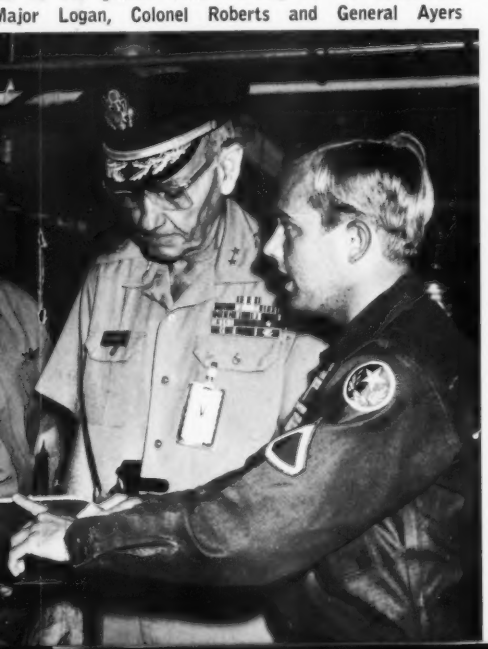
As the student progressed and gained confidence, he was absorbed into the operation as one of the working force while at the same time being closely supervised by a full-time employe of ARADMAC and his own platoon supervisors.

Platoon sergeants, technical inspectors and technical supply personnel were used within their area of responsibility. Even the mess personnel received training in the consolidated mess.

The final result was that a commander's desire to provide the best possible training for his men was rewarded with an opportunity to get each man involved in his specialty which, in most cases, was the first training he had received since attendance at an active duty school.

The success of the project has prompted plans for the unit to attend their 1970 annual training at ARADMAC for the second consecutive year. If these plans are carried out, the men of the 1249th Transportation Company will get another chance for additional training and an opportunity to bring themselves up-to-date on the latest developments and techniques in Army aviation.

djutant General for Texas, and Colonel Grady Roberts
tical Depot Maintenance Center (ARADMAC) for an
uty commander Colonel Frame Bowers. Below, a Na-
ce he has gained while working at the ARADMAC
Major Logan, Colonel Roberts and General Ayers



General Ayers inspects a UH-1 on the assembly line

Your Flight Instructor

READS

POTPOURRI

Two murals, one depicting the history of flight and the other showing aviation operations in the Republic of Vietnam are a continuing source of inspiration to soldiers stationed at Ft. Eustis, Va.

The paintings are by Specialist 5 Burdell Moody. They hang in the Airframe Repair Branch of the Aviation Maintenance Training Department of which Moody is a graduate.

The first mural, 15 feet long and 5 feet wide, entitled "Panorama of Flight History" depicts the story of flight. Moody used rich blue colors associated with space and the ethereal glow around the earth, and bright shades of orange to depict the violence of rocket propulsion. A plaque under the painting, quotes the words of Donald Douglas, aviation pioneer, "Only man's blindness, greed and inability to cope with himself and with his present, can halt or destroy aviation's upward progress."

The second painting is about the same size as the first and shows aviation operations in Vietnam. It bears a plaque written by Moody in dedication to all aviation maintenance personnel: "More glorious than praise, more lasting than words, is our honor to the men of Army aviation, who unselfishly gave their lives in the service of their country in Vietnam."

Moody, soldier-artist, completed a tour of duty in Vietnam as an airframe repairman and also as a crew chief. He was awarded the Air Medal with four Oak Leaf Clusters. After his regular tour of duty was over, he volunteered for the Army's Combat Artists Program overseas and covered operations with the Army, Navy and Air Force.

He has completed 10 canvases depicting scenes of the conflict in Southeast Asia which are now a permanent addition to the War Art Collection of the Department of the Army.

Maintenance personnel of the 17th Combat Aviation Group's 179th Assault Support Helicopter Company used a little "good old American ingenuity" and a 2-cent cork in order to save a $2 million CH-47 "Super C" Chinook.

The Chinook was severely damaged when it sustained heavy automatic weapons fire while hovering over Landing Zone Toughie in the Central Highlands of the Republic of Vietnam's II Corps Tactical Zone. One round crashed through the windshield, narrowly missing the aircraft commander's head.

Another round pierced the forward transmission, damaging the gears inside. Still another ripped through the number two engine and disabled it. Under such adverse conditions, however, the

pilots succeeded in flying the aircraft to Landing Zone Hard Times where it was shut down in temporary security.

Due to the possibility of an enemy mortar attack that night, it was decided to fly the aircraft to the security of Pleiku.

Examination of the transmission by an AVSCOM (Lycoming Engine) field representative revealed it could operate satisfactorily if the hole in the transmission case could be sealed in order to contain the 29 quarts of lubricating oil.

However, all the crew's work shaping the plug to fit the hole would be in vain if the Hook couldn't be flown to safety before the enemy attack. But the aircraft flight engineer finally gave the "all's ready."

The wounded bird was nursed down the runway gaining important momentum. With the perimeter looming ahead the Chinook staggered into the air and began a slow but deliberate climb. The crew breathed a sigh of relief at that achievement but braced for the many miles of uncertainty which lay ahead.

The shaky flight was perhaps hardest on the field representative who was drenched with hot oil as he held the vital cork in place. But the trip to Pleiku was made without incident and the harried flight ended with an uneventful running landing.

The Army Transportation School graduated two students from the first OV-1 Mohawk Maintenance Test Pilot Course at the Transportation Center, Ft. Eustis, Va., on 9 February 1970. The students were Major Donald A. Couvillion and Captain Richard C. Swinehagen.

This was a unique class for several reasons. It was the smallest class at the Transportation School and probably the smallest in the Army. The course was written and developed entirely from the assets within the school, keeping actual costs to a minimum. It is also the only fixed wing maintenance test pilot course within the Army.

The guest speaker for the graduation was Lieutenant Colonel Eugene R. Walsh who was one of the original initiators of the test pilot courses at the Transportation School. COL Walsh is the deputy project manager for the Manned Aerial Surveillance Target Acquisition System with the Aviation Support Command in St. Louis, Mo. He formerly was the chief of the Maintenance Test Flight Branch of Aviation General Subjects Division in 1966 at the Transportation School, and later served as the commanding officer of the Third Student Battalion of the school prior to his present assignment.

COL Walsh wears the Senior Aviator Badge, the Bronze Star, Air Medal with Oak Leaf Cluster, Meritorious Service Medal and the Army Commendation Medal.

A newly developed, high powered aerial weapon system was demonstrated last March by the U. S. Army Aviation Test Board at Ft. Rucker, Ala. It is the XM-140 (experimental) 30 mm automatic weapon mounted on a UH-1.

The gun has been put through a rigorous evaluation program. Two types of ammunition—armor piercing and a high explosive, dual purpose round were fired. Skid mounted cameras recorded the operation of the system while in flight.

THE SYSTEM

Lieutenant Colonel James T. Darrah Jr.

Plans and Programs Department
USABAAR

SAFETY PROCESS

System safety is defined as the optimum degree of hazard elimination . . . attained through specific application of management, scientific and engineering principles throughout all phases of a system life cycle

IT MUST BE extremely frustrating for anyone who casually comes across anything on system safety. Like other modern concepts, system safety is one with which few will argue in principle, but which is so broad in its application that details of its practical use escape most.

Most ideas proceed from the general to the specific. Perhaps what follows will help us along the way, at the same time realizing we have not fully arrived. The most that can be provided is just a little less frustration.

Starting with the most general aspects of the system safety concept, a review of its definition is in order. System safety is defined as the optimum degree of hazard elimination within the constraints of operational effectiveness, time and cost, attained through specific application of management, scientific and engineering principles throughout all phases of a system life cycle (adapted from MIL-STD-882). This definition is certainly general and states a philosophy of safety hard to contradict. It tends away from the cold absolute requirement of *no hazards* toward a more practical *optimum* solution. But there it stops, voicing an ideal, but short of telling the whole story. Though you may be stirred by visions of aircraft flying around with an *optimum degree* of their hazards eliminated, you're still not too sure how we're going to get there from here. Frustration begins and grows the more you think about it.

More insight into this concept is provided by the objective of system safety, adapted from MIL-STD-882. The objective of system safety is to enhance mission effectiveness through the conservation of human and material resources by the early identification, evaluation and correction of system hazards. This objective is attained by ensuring that:

1. Safe features consistent with mission requirements are designed into the system from the beginning of the design process.
2. Hazards associated with each system, subsystem and equipment are identified and eliminated or controlled to an acceptable level. When known hazards cannot be eliminated by design selection, control is established over these hazards to protect personnel and material.
3. Minimum risk is involved in the acceptance of new materials, concepts and production techniques.
4. Retrofit actions required to eliminate or control hazards are minimized through the timely inclusion of safety features during the acquisition of the system.
5. The historical safety data generated by other system programs is used.

The explanation of this objective and the means of ensuring its attainment help to understand the system safety concept, but they usually raise as many questions as they answer. We are still looking at ideals, with little said about how they are to be realized. More frustration.

As stated in its definition, system safety is a *life cycle* proposition. It begins with concept formulation and continues through to ultimate disposal of a system. A main source of frustration about this concept stems from the time element. When we say *life cycle*, we may be talking in terms of entire careers. Decades can pass from the time a system is conceived until it is no longer in the inventory. It is no wonder that we feel frustrated in trying to

THE SYSTEM SAFETY PROCESS

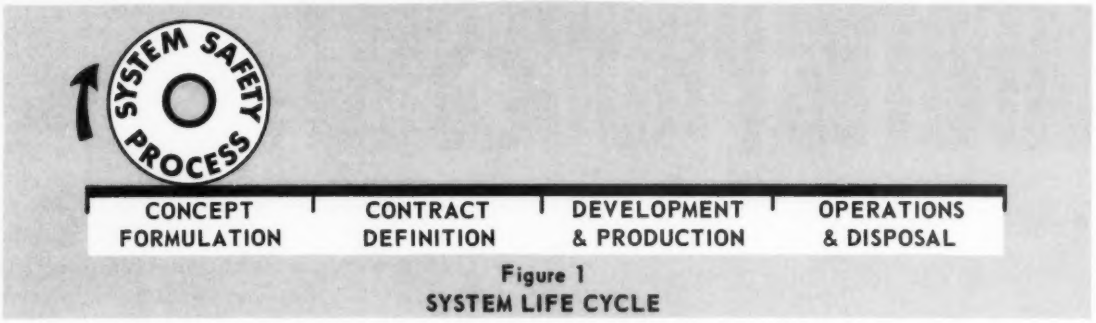


Figure 1
SYSTEM LIFE CYCLE

visualize the application of the system safety concept over so long a period.

To try to overcome some of this frustration due to the time element, the System Safety Process was developed. If the life cycle of a system is depicted along a horizontal time line, this process can be thought of as a wheel rolling along the line (figure 1). While it may be difficult to see the entire cycle at once, it should be easier to look at one revolution of the wheel. Understanding one revolution then leads to understanding all revolutions as the process rolls through the life cycle.

The System Safety Process is shown in figure 2. It is the logical approach to attaining the system safety objective. The steps of this process can be followed in sequence at any level of system complexity without destroying the basic idea. The process is repeated as necessary during the life cycle. Hence, the analogy with the wheel.

What follows is a step-by-step explanation of the System Safety Process as applied to any system. The description of the logical sequence of these steps, hopefully, will lead to a clearer understanding of how we get from here to there.

The System Process can begin at any point in the life cycle of a system, but its greatest advantages are achieved when it is first applied very early in the cycle. It is not too early to begin applying the process during initial concept studies which will ultimately lead to the production and use of a weapon system.

Block A, Known Precedent. This block represents the sum total of experience and knowledge gained from previous operations of systems related to the one under consideration. This experience and knowledge will rarely exist in any one place, so the effectiveness of the remainder of the process will depend on the ability to concentrate pertinent information at the point required for its use. Of particular interest are those measures taken previously to correct design features which have resulted in injuries and deaths or accidental damages and losses. Design features which have not proven unacceptably hazardous are also included here. Thus, the process logically begins with the identification and collection of pertinent information.

Block B, System Delineation. The second step in this process is to clearly state just what system is under consideration. The boundaries of the system and its elements must be defined as early as possible and revised as required during the system life cycle. Such delineation establishes the limits for succeeding steps in the process and reduces complex systems to manageable parts. For instance, if an aircraft system is being considered, it is essential to know whether the crew is being thought of as part of the system or not. Careful attention to this step prevents confusion later in the process.

Block C, System Hazard Analyses. The heart of the System Safety Process is the analysis of a system and its subsystems in a comprehensive and methodical manner. Beginning with preliminary hazard analyses of design concepts and continuing through a total hazard integration analysis of the complete system, this analytical process distinguishes system safety from other separate, but closely interfacing, disciplines. The detailed methods and techniques for performing these analyses are selected by engineers specifically qualified in this area. It is in this step that before-the-fact accident prevention has its beginning. The key to doing this lies in the comprehensive and methodical approach to analysis. By comprehensive, we mean that everything which could happen to the system is thought of in terms of the consequences which may result. The analyst continually asks the question, What if such-and-such happens? To do this without getting hopelessly bogged down in complex details requires a methodic or systematic approach to the analysis. The analytical tools for this are available and in use today.

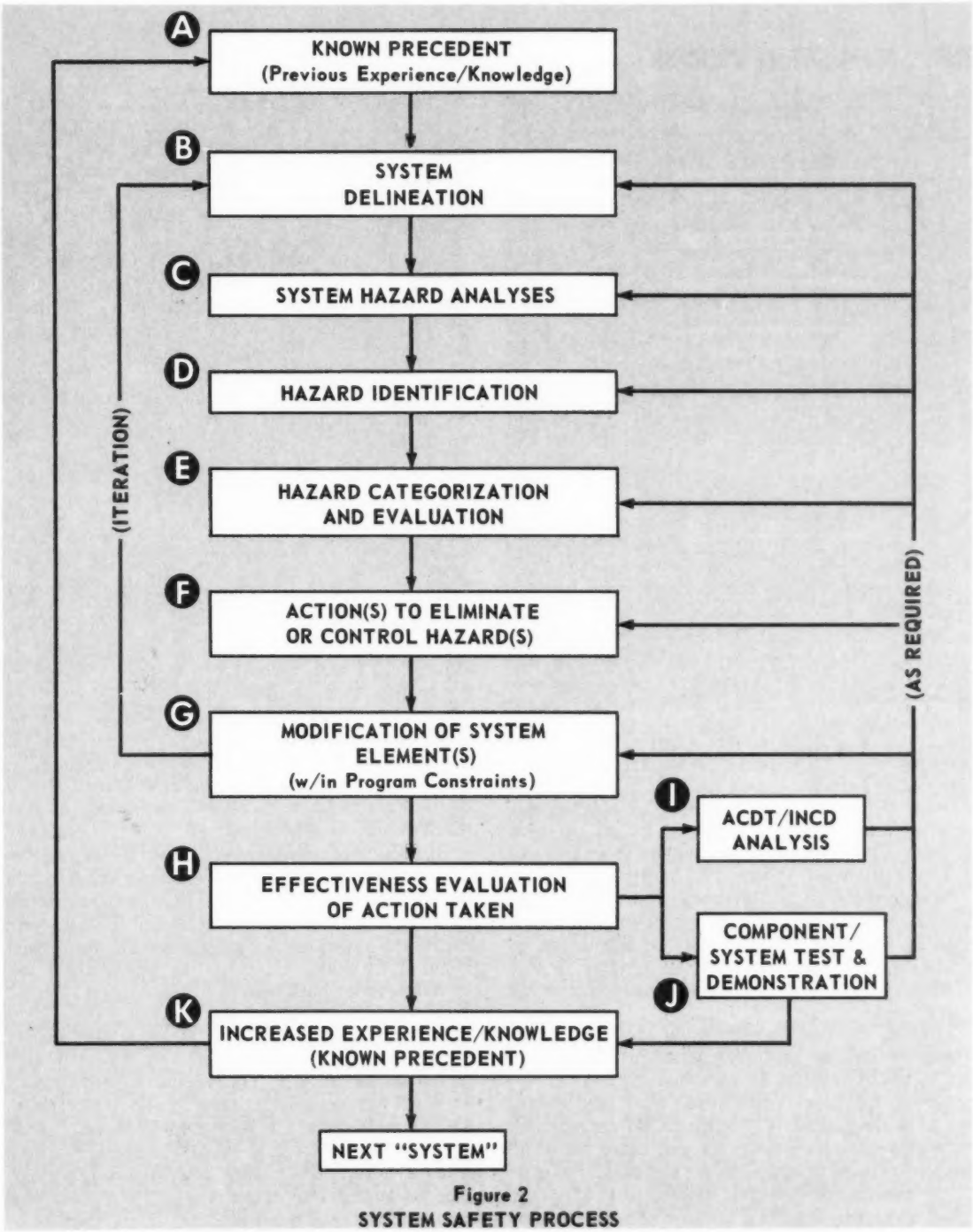


Figure 2
SYSTEM SAFETY PROCESS

THE SYSTEM SAFETY PROCESS

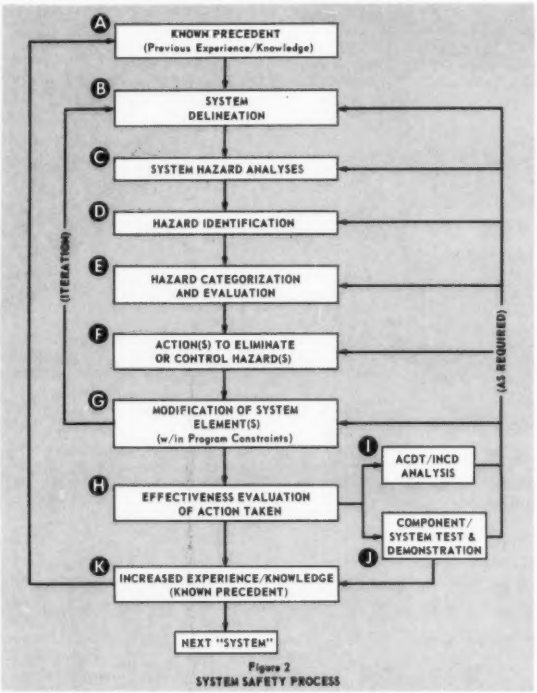


Figure 2
SYSTEM SAFETY PROCESS

The result is a high degree of assurance that no stone has been left unturned in the search for possible system hazards.

Block D, Hazard Identification. Through the systematic hazard analyses described in the previous step, the designer or engineer identifies those features of a system which potentially may cause injury, damage or destruction. The primary reason for going through the analysis is to arrive at this step. A hazard must be identified before it can be eliminated or controlled. The advantage of the process is that *all* hazards have been identified as near as possible at this point.

Block E. Hazard Categorization and Evaluation. To eliminate every hazard identified in the previous step is usually going to be impractical. For example, analysis of a helicopter system will show that separation of a rotor mast is a hazard with catastrophic consequences. As a result, we can make the mast stronger or more reliable, but we can neither eliminate the hazard nor give 100 percent assurance that it will never fail. Similar situations arise in examining the role of the human in a manned system. It is unlikely that we will ever totally eliminate his potential for making mistakes. The action to be taken as a result of hazard identification depends on the nature and degree of severity of the hazard. Categorization of hazards is a means by which corrective action can be guided, based on the degree of severity of the hazard identified. Priority for action should be assigned the most severe hazard, but this may not be possible, as explained above. To determine where priorities should be placed, the evaluation part of this step relates a hazard to its impact on system performance. It is here that judgment must be applied to ensure that maximum practical benefits are derived from this process. Responsibility for accomplishing this step is usually vested in the management of a system program as an essential element in the decisionmaking process.

Block F, Action(s) to Eliminate or Control Hazard(s). Nothing that has been done so far in the System Safety Process will prevent the first mishap. The process produces no useful result until some action is actually taken to eliminate or control the hazards that have been identified. Without proper and timely action, the process becomes ineffective. However, all steps taken up to this point have been designed so that the most appropriate action can be taken. Again, management is responsible for this step. This responsibility includes the decision and direction for action, plus the resources required to do the job. This is perhaps the most crucial step in the entire process because it is here that practical results are actually achieved.

Block G, Modification of System Element(s). Any action taken in the previous step will result in the modification of some element or elements of the system. This modification need not involve only hardware. For example, procedures can be revised, initial assumptions on operating environment can be amended or basic specifications can be changed. Since action modifies the system, the initial definition of the system or its elements also change, so the delineation of the system in block B must be revised accordingly. The process is then repeated, as required, until such time as no unacceptable additional hazards are generated by system modification. These repetitive steps ensure that actions taken to correct one hazard don't induce other hazards somewhere else in the system. There have been many examples of this happening in the past.

Block H, Effectiveness Evaluation of Action Taken. Up to this point in the process, hazards identified in the system through analysis have been eliminated or controlled within practical program limitations. If the technology of today were able to give us 100 percent assurance that we were 100 percent correct in all we have done so far, the process could end here. Since we cannot give these assurances, some measure of effectiveness is needed. A most difficult task in accident prevention is to tell how well we're doing. Recall that the definition of system safety prescribed an *optimum* level of hazard elimination or control. System safety does not promise the total elimination of all mishaps. But, despite our best efforts, if a mishap does occur, we can now be in a much better position to determine the *why* and *how,* having gone through this process. We already know a great deal about the things that can happen and how they affect the system.

Block I, Accident/Incident Analysis. In this step, any mishap is examined critically to determine causes and evaluate effects. The causes and effects could range from something already predicted as possible, or even probable under certain circumstances, to something entirely new and surprising. The results of this mishap analysis should then reveal deficiencies in the system safety process and serve to direct corrective action back to the appropriate step in the process. In this way, maximum use is made of the mishap experience, without having to go back and continually rediscover new truths.

Block J, Component/System Test and Demonstration. Another useful way to measure the effectiveness of the System Safety Process is through tests and demonstrations. Most, if not all, development programs for complex systems include testing to verify performance and the demonstration of systems capabilities. Both of these activities are, in essence, assuring functions. They are conducted to assure the user that his system performs as it is supposed to. System safety is also an assuring function. Tests and demonstrations normally performed on a system or its components are planned and conducted to reveal inadequacies in the System Safety Process. At the same time, these tests and demonstrations serve to verify the results of the process and give greater confidence in the assurances provided. As with the results of mishap analyses, deficiencies uncovered in this step are directed to the appropriate step in the process for corrective action.

Block K, Increased Experience/Knowledge. In those areas where the effectiveness evaluation (block H) and test and demonstration (block J) indicate that the System Safety Process has produced the desired results, the sum total of our experience and knowledge is increased correspondingly. This increased knowledge and experience is then applied the next time we go through the process, or it is used in applying the process to another system. In this manner, we continually build on past successes, while simultaneously correcting deficiencies.

That is the System Safety Process. At first glance, the overall picture may seem complicated and confusing. But when each step is considered individually, a logical and progressive pattern develops. It is really no more than a specialized problem solving process, one step leading naturally to the next. The System Safety Process also has several distinct characteristics which enable it to be applied in a practical manner. Provisions are made to repeat the steps as often as necessary to achieve the desired results. There are no blind alleys. The process can be applied at any level of system complexity, from broad general design concepts to the final details of a subsystem. Another significant practical characteristic of the process is that it prescribes the application of judgment and management decisions at the juncture between what is ideal and what is practical. Thus, the System Safety Process produces results which are consistent with the definition of system safety, attainment of an ". . . optimum degree of hazard elimination within the constraints of operational effectiveness, time and cost."

Actually, the application of the System Safety Process is not simple. But neither is a sophisticated weapon system simple. The advantage of the process lies in being able to examine such extremely complex subjects in simpler related parts. This examination proceeds in a logical and orderly fashion from one part to the next until the entire complex subject is covered.

This discussion of the System Safety Process has doubtlessly left unresolved many of the frustrations about the system safety discipline. However, it is hoped this discussion has served to somewhat clear the murky waters. As mentioned in the opening paragraphs, we have not yet arrived. The full potential benefits of the system safety discipline have yet to be realized. Perhaps the System Safety Process will help in achieving this goal.

problems encountered by the new breed of aviation safety officers in Vietnam

Give the New Aviation

ONLY A FEW YEARS ago, it was not unusual to report to an organization and find that the aviation safety officer was a field grade officer, wearing senior aviator wings. His aviation experience included an extensive background in maintenance, operations and standardization. In many cases, he had some command time under his belt. With his rank and well groomed background, he had very little difficulty in implementing a sound and effective aviation accident prevention program. In addition to these advantages, he was also surrounded by a wealth of aviation experience in assigned flight personnel and mechanics. As a result, aviation accident prevention was stressed throughout the organization as a part of the daily routine.

Rapid development of the Vietnam crisis brought about many changes in Army aviation. Manpower and equipment requirements made it necessary for the United States Army Aviation School and industry to step up production programs to meet new demands. As the intensity of the Vietnam conflict increased, the demands for more men and equipment increased proportionately.

The rapid turnover of manpower and the introduction of complex aircraft systems to the war zone brought about a changing pattern in the experience levels of aviation personnel. As the Vietnam conflict progressed, experience levels sank lower and lower, while the number of accidents and incidents rose higher and higher. It was during this period that the new breed of aviation safety officers came into being. The Department of the Army opened the Army Aviation Safety Officers' Course, conducted by the University of Southern California, to company grade officers and warrant officers. The goal was to initiate a renewed emphasis on aviation accident prevention, by assigning aviation safety officers all the way down to small unit level.

CW3 Leroy B. Spivey

Aircraft Accident Review and Analysis Department
USABAAR

Safety Officer a Chance

The new breed of aviation safety officer differed from his predecessors in many ways. Usually young, with little or no prior aviation experience, he was current in the newer types of aircraft and possessed a thorough knowledge of operational and tactical concepts. He was enriched with a newly acquired talent which made him a natural resource that commanders in the field could exploit and develop to their own advantage. In other words, he had become a new source of energy within Army aviation, which, if properly used, could provide the shot in the arm that aviation accident prevention programs needed so badly.

Armed with the educational tools of the aviation safety trade and a newly acquired philosophy that accidents could be prevented with the establishment of an aggressive aviation accident prevention program, the new breed of aviation safety officer departed the rigors of campus life to take his place alongside his contemporaries. It wasn't long after receiving his new assignment that he realized his place in the Army aviation safety field was very limited. Unlike the experienced field grade officer of yesteryear, he could not enjoy the privileges and prestige of his new position as a member of the commander's staff until he had proven that he was capable and mature enough to conduct a sound and effective aviation accident prevention program.

The first week or so in the new assignment ranged from complete frustration to a blind stage of agony. It was not long before he was labeled a radical because accident prevention represented a change to most people. Instead of receiving help and cooperation from the other key personnel within the organization, he was shunned and regarded as a spy sent down from headquarters. The maintenance officer didn't want him around the hangar because he claimed that he interfered with his work schedule. The operations officer believed too much time was taken up in conferences which hindered the accomplishment of the unit's mission.

Everywhere he turned people had a negative attitude toward aviation accident prevention. The harder he tried, the more difficult his job became. Frustrated and tired, he turned to his fellow aviators in a desperate search to find out where he had gone wrong. After a few aviation accident prevention lectures, where he pointed out that they destroyed aircraft by their unsafe flying practices, he soon lost the sanctuary of their company. Depressed and downhearted, he asked himself, "How can you help someone who doesn't want to be helped?" He returned to his office and the only company he had left, a stack of unprocessed aircraft accident reports.

Determined to make a success of his assignment, the new aviation safety officer drafted up an aviation accident prevention program tailored for his unit. In addition to making several surveys to outline problem areas within the organization, he made accurate charts and compiled the necessary data to support his program. Confident he had a workable solution, he requested and received an audience with the commander. With the poise and assurance of a Wall Street executive, he outlined his 11-point aviation accident prevention program and explained how its application would increase the combat effectiveness of the organization.

He emphasized that the commander's active participation in the aviation accident prevention program would give him the necessary backing that he needed to establish the decorum and respect of his position with unit personnel. He displayed operational SOPs from various assigned units to illustrate a lack of standardization. He then pointed out an urgent need to establish a strong and active aviation safety council to iron out many problems by sharing information. The commander smiled as though extremely pleased with the briefing, then said, "Young

Give the New Aviation Safety Officer a Chance

man, you've come up with some fine plans. However, with the war and all, we just don't have time to support a program of this magnitude. Right now, all I want you to do is concentrate on lowering our present accident rate. We've had three accidents already this month. I can't afford another."

The young safety officer stood motionless, saluted and said, "You're right, sir. Good day."

The results of his audience with the commander could very well have been the turning point in the dejected officer's life. For many of the new breed, it will be the first time in their lives they lose a complete sense of direction and reasoning. Unless someone comes along to appreciate their talents and capabilities, we'll undoubtedly have more individuals on our hands with this status quo attitude: *"If you can't beat 'em, join 'em."*

Many commanders accept the new breed of aviation safety officers with open arms. They quickly integrate them into their organizations, surrounding them with experienced personnel so the new breed's experience level can be developed. They are given responsibilities and active staff positions. Close surveys of units commanded by this type commander will disclose a highly professional unit with a low accident/incident rate and high morale.

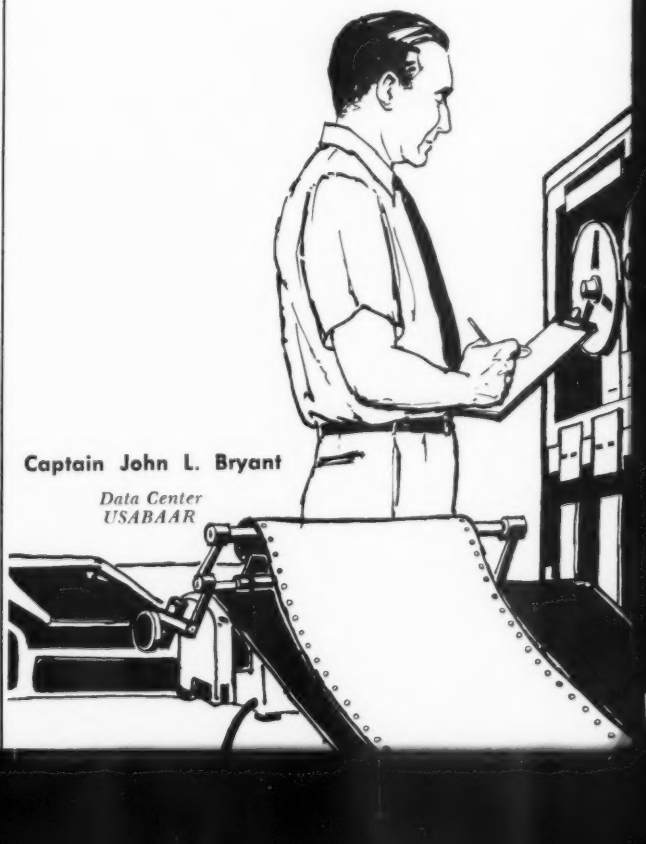
It is clearly evident that the secret to success of any aviation accident prevention program is command emphasis. Through the efforts of the commander, many of the problems that the new breed of aviation safety officer encounters can be eliminated overnight. When these young men report to your organization, take advantage of what they have to offer instead of criticizing them for their lack of experience. Remember, by developing their talents, you will strengthen your organization.

Though the new breed may not have extensive aviation backgrounds with experience in maintenance, operations and standardization, they are well equipped with solid foundations is aerodynamics, aircraft structures, aircraft electrical systems, aviation psychology, aviation physiology, management, communicative skills, accident prevention and investigation techniques. In addition to this technical background, the new breed know how to conduct effective aviation accident prevention programs. All they need is a chance!

Computer

USABAAR HAS JUST installed a computer system capable of recording and correlating more information concerning aircraft mishaps than any other system in existence. But it can't do a thing until it's fed information from you—commanders, safety officers and aviators. *You* are the most important part of the Army's aviation accident prevention program. To make this system work, *you* must report *all* aspects of mishaps accurately and clearly.

To help you accomplish your responsibilities, whether you are a graduate of the USC Army Aviation Safety Course or untrained in mishap investigation, we have developed a new series of mishap reporting forms for thorough and accurate investigations. These forms request information about men, machines and environments involved in mishaps in a manner that allows you to simply check blocks or fill in blanks. In most cases, this will make it easier for you to record far more detailed information. In addition to accidents, this new reporting system requires you to investigate incidents, forced landings, precautionary landings and ground mishaps. This will provide more valuable information to be used in the Army aviation mishap prevention



Captain John L. Bryant

Data Center
USABAAR

Aviation Mishap Analysis System

program. For example, it can be used to find and replace defective parts or design a safer seat or harness.

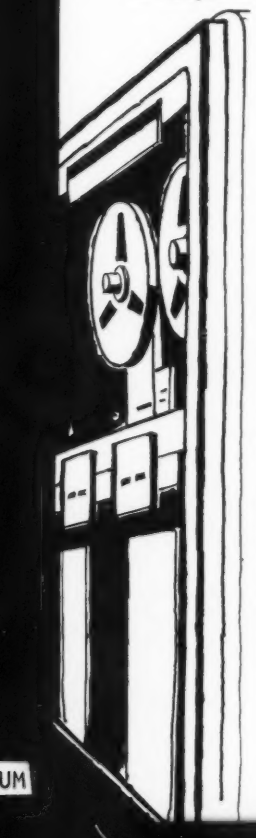
The new DA Form 2397 series consists of 17 forms, most designed to address specific items which may have been involved in mishaps, such as fire, escape problems, maintenance or materiel problems, etc. The system is designed so that you only need to submit the forms that apply to problems which were found to have contributed, or suspected of contributing, to mishaps.

The accompanying table describes current ideas concerning when the various forms of the new 2397 series should be submitted.

It is important to understand, however, that a particular problem area may have contributed to the mishap and yet not be considered a cause factor. USABAAR is interested in obtaining information on all conditions present at the time of the mishap, whether they were considered to be a direct cause of the mishap or not. If, for example, a crew member had been overworked and was in need of sleep, his condition may not have caused the mishap, but it may, in combination with other factors, have contributed to the cause of the mishap. These new forms have been designed so that you can record this information accurately to help obtain a much clearer idea of how similar mishaps may be prevented in the future.

The efficiency of this new system, as you can see, lies entirely in your hands. Commanders must have mishap investigation boards appointed and well briefed on how to conduct mishap investigations in accordance with AR 95-5 and AR 385-40 long before mishaps occur. This allows investigators to begin investigations as soon as they are notified of mishaps, without losing valuable time learning how to conduct investigations. Safety officers at all levels should be well informed so they may intelligently counsel investigation boards and assure timely and accurate reporting. All aviators should become familiar with mishap investigation techniques so they may conduct efficient and accurate investigations when required.

In return for your cooperation, USABAAR will analyze and correlate your mishap investigation reports to assure you of the best and safest equipment and procedures possible. We're trying to save your lives. Give us a hand!



FORM NUMBER	TITLE	P/L	F/L	I	G	A
2397	Reviewing Official's Statement	N	N	N	N	Y
2397-1	Summary of Mishap	Y	Y	Y	Y	Y
2397-2	Findings and Recommendations	Y	Y	Y	Y	Y
2397-3	Narrative of Mishap	N	N	A/R	A/R	Y
2397-4	Witness Statements	N	N	A/R	N	Y
2397-5	Wreckage Distribution	N	N	A/R	N	Y
2397-6	Crash Survivability Report	N	N	N	N	A/R
2397-7 & 7A	Maintenance/Materiel Malfunction/Failure	A/R	Y	A/R	A/R	A/R
2397-8	Personal Data	N	N	Y	Y	Y
2397-9	Psychophysiological and Environmental Factors	N	N	A/R	N	Y
2397-10	Personal/Protective Equipment	N	N	A/R	N	A/R
2397-11	Medical Information	A/R	A/R	A/R	A/R	A/R
2397-12	Emergency Evacuation	A/R	A/R	A/R	N	A/R
2397-13 & 13A	Ejection or Bailout	N	N	A/R	N	A/R
2397-14 & 14A	Survival and Rescue	A/R	A/R	A/R	N	A/R
2397-15	Fire Data	A/R	A/R	A/R	A/R	A/R
2397-16	Weather Data	A/R	A/R	A/R	A/R	Y
2397-17	Facilities	A/R	A/R	A/R	A/R	A/R

P/L - Precautionary Landing
F/L - Forced Landing
I - Incident
G - Ground Mishap
A - Accident

Y - Form will be required
N - Form is not required
A/R - Form will be submitted when the data listed on this form pertains to the mishap

CW4 Robert Graben

Education and Prevention Department
USABAAR

THE WILL TO LIVE

the author wishes to credit Dynamic Science, Phoenix, Arizona, for information contained in this article

I'M SURE MOST of you have known of cases where the statement was made, "He never would have made it but for his will to live." This statement is usually made after the fact. How about the will to live before the accident happened? The pilot who flies without his protective equipment or who wears it improperly does not have the will to live in my book.

Our protective equipment and restraining devices may not be the last word, but research and technology are bringing us closer and closer to that goal. In the meantime, we, as aviators and crewmen, must take full advantage of what we're issued. Using this equipment properly, we can reduce the possibility of injuries—yes, and even fatalities—by as much as 75 percent in many aircraft accidents.

Why do we continue to have serious injuries and deaths in so many survivable accidents? A survivable accident is one in which the occupied area of the aircraft is relatively intact and/or forces applied to occupants during the crash should not have caused death or serious injury.

One of the surest methods of crew longevity in case of an impending crash is an escape device to separate man from machine before impact. However, the majority of us do not enjoy this luxury and are forced to remain with the aircraft. It is that fraction of a second during the crash sequence when the decelerative forces are at their peak that the story of crash injury is really told. You can come out of the wreckage with no injury, slightly injured, seriously injured or dead. In case of the latter, when the crash forces were not severe enough to cause death, and/or the living area was intact, we must ask why.

The first Army aviation fatality happened in 1908 at Ft. Myer, Va., when Lieutenant Tom Selfridge was killed in a Wright Brothers' aircraft. A propeller broke during takeoff and Lieutenant Selfridge's head struck a wing support. He was not restrained in his seat, nor did he wear any protective headgear.

That was in 1908. In 1970, we continue to kill and maim ourselves, not because we don't have the proper equipment, but because we fail to use it correctly. A helmet that does not fit and comes off at impact could just as well have been left in the locker. Even more tragic is the crewman who suffers death or severe burns, when in that same locker hangs a Nomex flight suit he cannot wear because of the whim of some individual.

We spend millions for research and development of such things as fire retardant flight suits. Yet, aircrewmen wearing fatigues or other non-fire retardant apparel are still killed or seriously burned in accidents. Postcrash fire is not a rarity. It is present in a great percentage of our Army aircraft accidents today, so let's get smart and get our aircrews into available equipment. It works both ways —you who have protective suits and gloves and are allowed to wear them, take my advice and WEAR THEM!

Another aspect of the crash sequence concerns restraint systems designed to hold up in position so we do not become missiles within the structure dur-

ing a crash. With a couple of minor exceptions, these systems are adequate. But we still report injuries because of improper adjustment. Severe abdominal injuries occur because lap belts were riding too high; bones are broken in the upper torso because of shoulder harnesses worn too loose; etc. This list goes on and on.

The lap belt should be positioned across the body at a 45- to 55-degree angle, so it is intact with the skeletal portions of the hip. First, adjust the belt snugly, but not so tight as to make it uncomfortable. Then adjust the shoulder harness so it allows you to place a clenched fist between your chest and the belt. Check the inertia reel as prescribed for your particular aircraft. If it works, the restraining system should give you maximum protection.

Aircraft commanders should never take it for granted their crews are properly restrained. They should check them out before flights and brief them on the correct use of restraints. Flailing bodies due to improper restraints cause the majority of crash injuries. They can be reduced through a little more attention to detail.

Loose items in aircraft, an unsecured fire extinguisher for example, can become deadly missiles during accidents. Check closely for loose items during preflight. It only takes a few more minutes and can pay high dividends.

One last thought to you who use nice soft store-bought seat cushions, or those cool cushions from the local gas station. Don't use them! Army aircraft seat cushions have been engineered to give specific protection for human body decelerations during crashes. They provide a uniform deceleration which, under given g loads, will not cause the human body to "peak out" beyond human tolerance. Those soft sponge rubber pads or cool cushions will allow you to travel greater distances at impact. This also means longer times, with subsequent bottoming-out at the seat pans with greater peak g's. Your bones may be able to take it, but what about those vital organs suspended within? What happens to them?

Tests have proven the human body is exposed to twice the g loads of aircraft at impact, due to a term known as *overshoot* (dynamic). This is simply the tendency of body fluids, suspended organs, etc., to continue to accelerate after the structure has stopped. The quicker the body stops, the greater the *overshoot*.

If it has been determined through an accident investigation that an aircraft impacted with 5 g's, it can be assumed a load of 10 g's was placed on the occupants, if they were sitting on seat cushions provided by the Army. This g load will skyrocket

with seat cushions *you* buy for comfort. Your spinal column is a pretty sturdy set of bones, but let's give it a greater chance to hold together in a crash.

Studies of case histories involving fixed and rotary wing aircraft show that the greatest number of fatalities occur in accidents involving postcrash fires. These same studies show the number of deaths and serious injuries during postcrash fires is much higher in helicopters than fixed wing aircraft. This can be attributed mainly to the proximity of crews and passengers to the fuel and the structural confinement. In fixed wing aircraft, it is possible to get much more distance between the two by installing fuel tanks in the wings. In helicopters, we literally sit on the fuel. Just in the nature of the beast, we seem to get involved in high vertical impact force type accidents which also tend to leave spilled fuel in near proximity to crash sites.

Temperatures in excess of 500° F in cabin areas in less than 1 minute, with fuselages burning through shortly thereafter, have been recorded during crash tests of many helicopters. It is imperative that we know exactly how to evacuate the wreckage as quickly as possible in the event of an accident. One of the best ways to accomplish this is a comprehensive briefing about what to do in case of a crash. Passengers must be made aware of the locations of exits and how they operate. They must be warned about all items, no matter how insignificant they may seem to you, which might hinder escape.

The first question that usually arises at this point is, How can I brief my passengers when they are boarded while the aircraft is running and I am in the cockpit? If that is the case, there are still two big factors you have going for you—*leadership* and *crew training*. Crews possessing these qualities should have no problem maintaining cabin discipline during emergencies. Sure, it's difficult to get passengers to remain seated and strapped in as your helicopter slowly sinks into the sea. However, if the crew remains seated and secure and has explained the hazards of leaving the aircraft, such as spinning rotors, passengers are likely to follow suit.

When it's briefing time before a flight, never assume your passengers have heard the briefing before. All it takes to have a fatality is one man who panics because he doesn't know the exit locations and ends up trapped.

The time interval following a ditching or crash, during which survivors in the aircraft remain physically able to make rational escape attempts, has been called the *escape time*. In case of postcrash fire, this *escape time* may be limited by any of these physiological factors—burn injuries, respiratory system damage, carbon monoxide poisoning and suffocation. Since helicopters and light aircraft are consumed much faster than large aircraft, crews and passengers must understand the reasons for speed during evacuation.

There are case histories of fatal aircraft accidents involving postcrash fires where charred bodies were found sitting in their seats. One passenger who survived a civil crash stated, "You people tell me when to get to the airport, what gate to enter, where to sit and what I will eat, so I thought you would tell me when to get out." He was lucky. This clearly illustrates that you can never assume your passengers will do the right thing after a crash, because, in most cases, they won't.

Now for a short recap on postcrash fires. Remember, helicopters are the most vulnerable to fires. All emergency exits must be clearly marked and briefing passengers about their operation is a must. Leadership and crew training probably pay the greatest dividends in postcrash escape. Never assume passenger knowledge of correct escape procedures. Most passengers need to be carefully led.

Emulsified fuels, crash resistant fuel cells (now in production for the UH-1D/H) and breakaway fittings for fuel and oil lines in those cases where the engine tears loose are a few examples of the intensive research and development to reduce the postcrash fire potential. There may come a day when postcrash fire is a thing of the past. Let's hope so. In the interim, we must make do with what we have and increase our margin of survival. Aircraft fires are nothing new. Study *your* aircraft, know what its characteristics are during postcrash fires and use this knowledge to get your passengers and crew through a crash and fire with minimum injuries.

I have not elaborated on any topic, but I hope the point has been clearly made that we all can do more to increase our chances for survival by using common sense and sound judgment, and by paying just a little more attention to detail. Let's all pitch in and reduce needless injuries and deaths in survivable accidents. The first place to start is with ourselves.

CHOPPER TALK

Patsy R. Thompson

Education and Prevention Department
USABAAR

"DON'T TELL ME you're down for treatment again!" exclaimed an ailing Chinook.

"That's about the size of it," moaned a Huey. "I spend more time in this maintenance hospital than I do flying. I know I'm not as young as I was, but I still have a lot of good hours left, if those pilots would just give me a little tender loving care. Yesterday, I was being readied for a resupply trip. Before it was over, I was loaded to the hilt. I was so overweight I was miserable.

"Reluctantly, I took off and climbed to 50 feet. Suddenly, my pulse dropped from 6600 to 5800, and the next thing I knew I was falling like a duck shot from a blind. Luckily, I escaped with only a fractured skid and cross tube. If that young pilot had given me a chance to use my go no-go instinct, I wouldn't be in this condition. Those gung-ho pilots should realize we have our limitations, just as they have. I wonder how many of them could compete with Charles Atlas in a weight lifting contest!"

"Amen!" groaned the Chinook. "Some of them don't consider our welfare. All they think about is accomplishing their missions, no matter how they affect us. My aches and pains were caused by a pilot hovering me into my revetment in a strong gusty wind—to top it all, with no ground guides or crew coordination! He got me into the revetment all right, but not until I hit the wall and broke a blade. It's a miracle I wasn't hurt worse!"

One of the other patients in the ward who had listened intently to its colleagues complain could control its tongue no longer. "You sure are giving the pilots hell, aren't you? I know statistics say pilots are our worst enemies, but what about their supervisors? In many cases, nonrated ground commanders are not aware of helicopter or pilot limitations and send us off on unrealistic missions. When we're injured, the poor pilots usually get the short end of the stick. Don't say it! I know what you're thinking! But how many pilots will refuse a mission, even though that little voice inside keeps saying, 'Don't go! Don't go!'? Very few!

"Just the other day, one of our cohorts met its end on a rescue trip. Its pilot was sent into known deteriorating weather to pick up a man with a broken leg. Of course the man was in pain, but he could have survived a few more hours until the weather lifted. It would have been better for him to suffer a little than not make it back at all.

"And don't forget our maintenance doctors! How many times have one of us been injured because of a misplaced instrument which was not detected during the windup of an operation? That's what I call lousy surgery! But this isn't the only problem. Have you ever left the hospital feeling you didn't get proper or adequate treatment? Frustrating, isn't it?

"One instance that always comes to my mind is an accident a Sioux had. It was taking off from a confined area and had just cleared the trees when it began to settle, struck the trees and was fatally injured. Its physical records for the past 6 months indicated it had been treated many times for several illnesses. Evidently the doctors didn't cure one or more of them.

"I could spend days talking about accidents some of our cohorts had due to human error. But we must remember we aren't exactly infallible ourselves. Some of our parts malfunction or fail from stress or old age. In most instances, we get on the ground safely. But if one of our major organs fail, we've had it! There's not much pilots, supervisors or maintenance doctors can do to cure these types of ills, but there is something they can do about theirs. The key to human error is an effective accident prevention program. But just mention SAFETY to some people and they act like it's a four-letter word. What they don't realize is that an ounce of prevention is worth a pound of accident experience. Agree?"

"I'll go along with that," said the Huey. "But what can we do about it?"

"Nothing. That's our big problem! The only way we'll ever have a normal life span is for supervisors at all levels to take steps to curb our increasing injury and death rates. Until this happens, we're doomed!"

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

BROKEN COMMUNICATIONS

AFTER A HOVER check, a UH-1 took off from an LZ with a crew of four and 11 passengers aboard. It cleared the trees and had climbed to about 100 feet when a loud bang was heard from the rear and power was lost. The aircraft commander went into autorotation, shut off the fuel, flared to slow the helicopter and entered the trees. It settled vertically, cutting trees as it fell, and bringing branches and leaves down on top of it. The impact was level and hard. All occupants sustained decelerative injuries.

The aircraft commander did not have his helmet visor down. During the descent through the trees, a 3-inch twig entered his left eye cavity and penetrated the left frontal lobe of his brain.

The survival radio, lying on the floor, was thrown out at impact and its antenna was broken off. This presented a serious rescue problem. Covered with debris from its fall through the trees, the helicopter was nearly invisible from above. Attempting to aid their rescue, the crew popped smoke grenades to mark their location. Because of the dense jungle canopy and calm air, only a thin wisp of smoke coiled upward. Fortunately, this was seen by the crew of another Huey and the rescue was made.

The following oft repeated points are clearly illustrated by this accident:

If his helmet visor had been down, the aircraft commander would have been protected from the twig.

If the survival radio had been worn or secured, it could have been used for rescue.

Even a million dollar piece of equipment isn't worth a plugged nickel if it isn't worn or used properly.

PEARL SAYS:

"For maximum protection and comfort, wear your two-piece Nomex flight clothes with the tail tucked in your trousers, the trouser legs closed snugly over your boots at the ankles and your wrist openings closed snugly over your Nomex gauntlets. Velcro fasteners are provided at wrists and ankles to provide snug fits. Any deviation, such as shirt sleeves rolled up, shirt tail out or trouser legs bloused means that much less protection, comfort or both. I also fly with my helmet visor down for face protection."

CUT ALONG LINE AND DISPLAY IN PROMINENT PLACE

PEARL SAYS:

"This shirt, pullover, sleeping, heat retentive and moisture resistant, is a No-No for aircrew members to wear under Nomex flight suits, or any other flight clothing for that matter. The label in the shirt states it is made of 80% triacetate and 20% nylon. Both are thermoplastic materials and melt at comparatively low temperatures. This alone establishes this garment as undesirable for post-crash fire protection, regardless of the type clothing worn over it. Even with fire retardant materials such as Nomex, there can be enough heat transfer in a severe fire to melt the materials the shirt is made of. The molten fabric will adhere to skin, producing severe burns. This is not the case with wool or cotton undergarments. Following are the federal stock numbers for the different sizes of this shirt. Please take my advice and don't wear this shirt when you fly."

Small	FSN 8415-890-2100
Medium	FSN 8415-890-2101
Large	FSN 8415-890-2102
X-Large	FSN 8415-890-2103

HISTORY OF OH-13 MISHAPS

THIS ARTICLE was prepared to help commanders, aviation safety officers, maintenance officers and other aviation personnel prevent future mishaps. The term *mishap* includes accidents, incidents, forced landings and precautionary landings, as defined by paragraph 7, AR 385-40. Helicopter losses or damages which were the direct result of hostile action were not included. The data presented was taken from accident and other mishap reports submitted to USABAAR from all Army commands, as required by Section IV, AR 385-40.

Table 1 shows total OH-13 mishaps from 1 July 1957 through 30 June 1969. Of 3,411 mishaps, 880 (26 percent) resulted in accidents. Incidents, forced landings and precautionary landings accounted for the remaining 2,531. The OH-13 accident rate during this 12-year period was 41.8 per 100,000 flying hours, computed on the 880 accidents which occurred during 2,107,141 flying hours. The total cost of accidents and incidents reported during this period was $18,761,319. Figure 1 shows the dollar costs of accidents by model. There were 286 crew injuries, of which 65 resulted in fatalities. Table 2 shows a detailed breakdown by injury classification for each model.

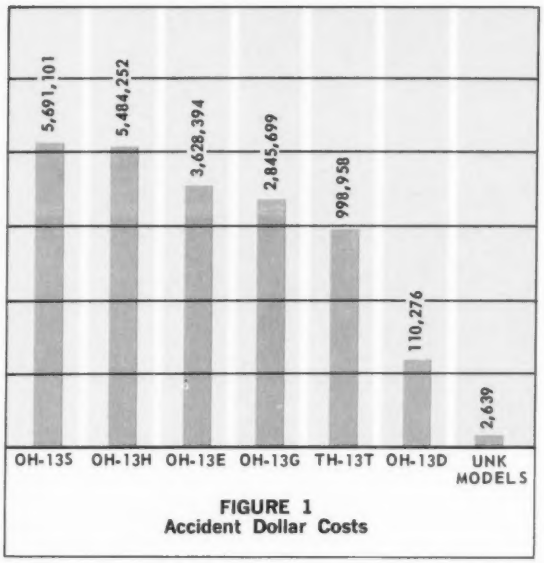
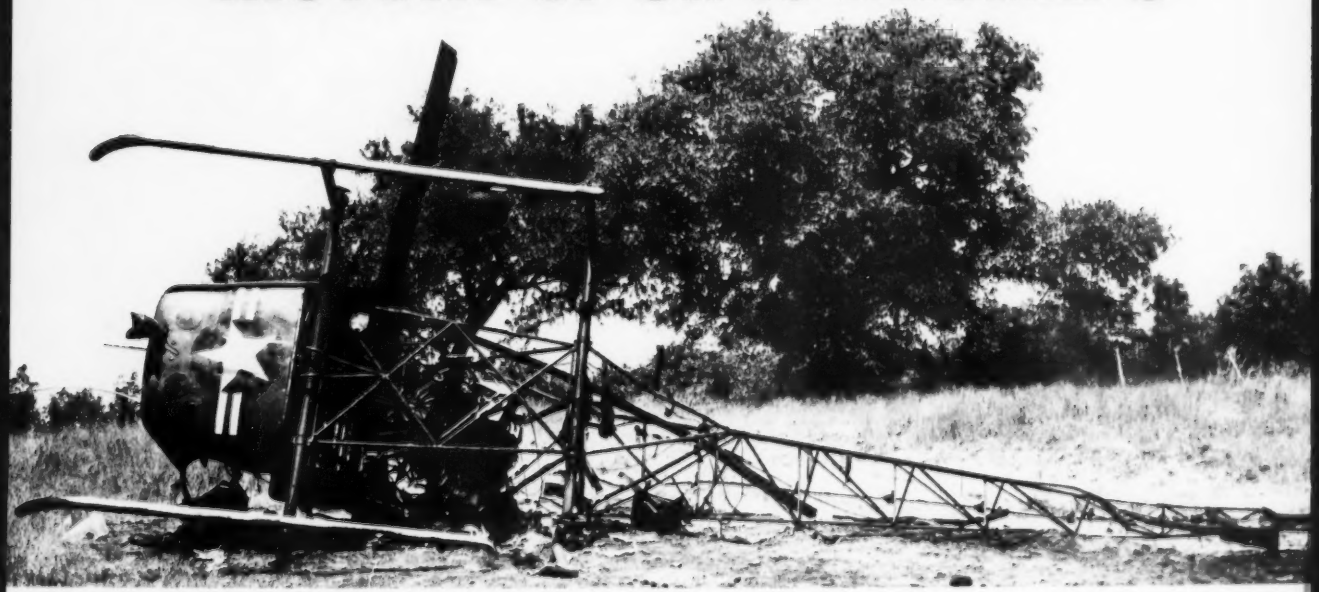


FIGURE 1
Accident Dollar Costs



The greatest cause of postcrash fires in all OH-13 helicopters was failure to contain fuel in the tanks during crash impact forces. Of 101 postcrash fires, the majority were caused by loss of tank filler caps, tank rupture at impact and tanks being struck by objects. All OH-13G, H, S and T models now have redesigned fuel tanks, making them more crash resistant. Table 3 shows the number of fires by aircraft model.

The majority of Army aircraft accidents are caused by materiel failures and crew error. For the OH-13, materiel failures and malfunctions represented approximately 61 percent of all the mishap cause factors and 28 percent were related to crew error. Table 4 shows the number of cause factors by OH-13 model. The most often reported factors were materiel failures and malfunctions, crew error, other personnel, weather and maintenance.

Crew errors are shown in table 5. Incorrect use of flight controls accounted for approximately 19.4 percent of total crew errors; misjudged distance and/or altitude, 16.6 percent; and failure to see object before impact, 15.9 percent. Examples of incorrect use of flight controls are pitch application too late to avoid hard ground contact; allowing helicopter to strike ground tail first by applying full aft cyclic; and excessive sink rate with low air speed just prior to applying initial pitch.

William P. Christian
Aircraft Accident Review and Analysis Department
USABAAR

A detailed breakdown of engine problems, shown in table 7, indicates that spark plug fouling caused 18.7 percent of the total engine malfunctions. Other problems, such as cooling fan drive belt failures, drive quill and fan blade failures, and TH-13T and OH-13S turbocharger failures accounted for the majority of the remaining factors. Cooling fan failures have been reduced by glass shot peening the disc assemblies to spread the stress concentration over the complete disc. This was accomplished in accordance with unclassified message AMSAV-R-EYA 11-1317, dated 8 November 1968.

TH-13T and OH-13S turbocharger failures have been attributed to personnel not complying with the Operator's Manual requirement to allow a cooling time of 4 minutes at 2300 rpm prior to engine shutdown. This cooling time is vitally important for cooling the turbocharger assembly to prevent coking and cracking of the turbocharger housing.

TABLE 1
Mishap Classification

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	MODEL UNK	TOTAL
MAJOR ACCIDENTS	8	179	135	270	155	17	0	764
MINOR ACCIDENTS	1	46	21	36	4	2	6	116
INCIDENTS	0	159	145	136	111	27	0	578
FORCED LANDINGS	3	166	127	121	42	106	4	569
PRECAUTIONARY LANDINGS	0	119	170	101	86	906	2	1384
TOTAL	12	669	598	664	398	1058	12	3411

TABLE 2
Injuries

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	TOTAL
MAJOR INJURIES	0	6	1	15	9	5	36
MINOR INJURIES	0	31	24	73	54	3	185
FATAL INJURIES	0	10	11	19	9	16	65
TOTAL	0	47	36	107	72	24	286

TABLE 3
Postcrash Fires

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	TOTAL
NUMBER OF FIRES	0	6	12	39	36	8	101

HISTORY OF OH-13 MISHAPS

Another recent problem with OH-13 helicopters is internal corrosion of center frames and tail rotor boom assemblies. To date, more than 150 OH-13s have been found with severe internal center frame and tail boom tube corrosion. Action is being taken to revise the maintenance manuals of all OH-13s, requiring annual X-ray inspections for internal corrosion. An unclassified message, AMSAV-R-EYA, dated 19 December 1969, was issued by the Commanding General, United States

TABLE 4
Established Cause Factors

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	MODEL UNK	TOTAL
CREW ERROR	6	273	191	260	150	31	3	914
MATERIEL FAILURE	4	290	306	254	123	758	4	1739
MATERIEL MALFUNCTION	0	16	28	7	9	183	0	243
OTHER PERSONNEL	2	30	22	43	38	20	0	155
CHIP DETECTOR	0	2	3	1	1	13	0	20
MAINTENANCE	0	11	10	7	6	30	0	64
FACILITIES	0	2	0	0	3	0	0	5
COMMAND SUPERVISION	0	2	2	3	6	6	0	19
WEATHER	0	30	16	41	9	0	0	96
DESIGN	0	0	0	0	0	0	0	0
TRAINING	0	0	0	0	0	0	0	0
PHYSIOLOGICAL	0	1	0	0	0	0	0	1
PERSONAL EQUIPMENT	0	0	0	0	0	0	0	0
TOTAL	12	657	578	616	345	1041	7	3256

TABLE 5
Crew Errors

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	MODEL UNK	TOTAL
Incorrect use of flight controls	1	60	32	50	30	6	0	179
Misjudged distance/ altitude	1	57	28	49	17	0	0	152
Failure to see object	2	39	30	41	34	0	0	146
Improper auto procedures	0	14	16	18	10	5	1	64
Inadequate evaluation of circumstance	0	12	10	24	9	2	0	57
Improper use of engine controls	0	9	11	19	9	7	0	55
Failure to supervise flight	0	18	11	10	5	0	0	44
Failure to compensate for weather	1	9	10	13	7	0	1	41
Hard landing	0	4	18	3	12	3	0	40
Improper preflight	1	14	6	12	3	1	1	38
Failure to maintain flying speed	0	14	11	6	4	0	0	35
Improper use of fuel system	0	18	3	4	4	0	0	29
Violation of orders/ regulations	0	4	2	9	0	0	0	15
Midair collision	0	0	2	0	3	5	0	10
Tail boom chop	0	1	1	2	3	2	0	9
Total	6	273	191	260	150	31	3	914

Army Aviation Systems Command, requiring that all OH-13E, G and H models be inspected by 1 April 1970.

A concerted effort on the part of commanders and supervisors at all levels is required to achieve a more effective aviation accident prevention program. This can best be accomplished through:

1. Knowledge of past mishap experience and cause factors which are available through weekly and monthly mishap summaries. Distribution of weekly and monthly summaries may be obtained by writing to: Director, USABAAR, ATTN: Education and Prevention Department, Ft. Rucker, Ala. 36360.

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5. Increased command emphasis on investigation and reporting of incidents, forced landings and precautionary landings, to include all information required by paragraph 23e, AR 385-40.

TABLE 6
Materiel Failures and Malfunctions

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	MODEL UNK	TOTAL
INSTRUMENT SYSTEM	0	18	25	10	3	78	0	134
TAIL ROTOR SYSTEM	1	23	21	27	19	33	1	125
ELECTRICAL SYSTEM	0	6	10	4	3	79	0	102
FUEL SYSTEM	0	7	2	15	5	47	0	76
CHIP DETECTOR	0	20	19	1	0	34	0	74
HYDRAULIC SYSTEM	0	5	6	3	7	50	0	71
FLIGHT CONTROLS	0	10	13	12	7	28	0	70
MAIN ROTOR SYSTEM	1	10	6	12	5	24	0	58
TRANSMISSION	0	6	4	9	3	11	0	33
AIRFRAME	0	1	2	5	0	6	0	14
LANDING GEAR	0	0	6	1	1	0	0	5
ENGINE	2	200	223	162	79	551	3	1220
TOTAL	4	306	334	261	132	941	4	1982

TABLE 7
Engine Failures and Malfunctions

	OH-13D	OH-13E	OH-13G	OH-13H	OH-13S	TH-13T	MODEL UNK	TOTAL
SPARK PLUGS	0	29	34	23	3	140	0	229
CYLINDERS/PISTONS/ VALVES	0	43	65	32	6	42	0	188
COOLING SYSTEM	0	9	11	8	28	103	0	159
UNDETERMINED	1	27	36	22	11	60	0	157
TURBOCHARGER	0	0	0	0	15	110	0	125
CARBURETOR/MIXTURE	0	15	16	14	5	29	0	79
OIL SYSTEM	0	32	23	7	3	10	1	76
MAGNETO	0	7	17	17	1	21	0	63
MISC (CRANKSHAFT/ SEALS)	0	14	11	8	1	23	0	57
CONNECTING RODS	1	22	7	16	1	1	2	50
ENGINE CONTROLS	0	2	3	15	5	12	0	37
TOTAL	2	200	223	162	79	551	3	1220

Engine failures and/or malfunctions represented the largest proportion (61%) of this group.

HISTORY OF OH-13 MISHAPS

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STRANGER IN TOWN

CW3 Junius A. Jordan

Education and Prevention Department
USABAAR

ANNUAL AWARD
Monthly Winner
CONTEST

A GLEAMING 727 lands and taxies to the terminal. An airport attendant pushes a button in the side of the airplane and the steps come out. As the passengers step down, we see a mixture of civilians and military. There is nothing unusual here. We see the same thing at hundreds of airports across the nation.

But let's select one man and follow him. How about the warrant officer at the bottom of the stairs, smiling at the stewardess? Let's call him Mike. There's nothing unusual about Mike. He picks up his baggage, hails a cab and goes to a motel. In his room, we find him unpacking extra uniforms, flight suits, shorts, socks—the usual gear you expect a man to carry. After unpacking, he makes a phone call, then lies back and relaxes.

After lying there about 30 minutes, Mike hears the blast of a horn from outside. Hurriedly, he stands, checks his appearance in the mirror, grabs up his jacket and attache case and leaves. Outside, he talks with a man who has him sign a paper, then gives him the keys to the car. Mike starts the car and drives to a nearby military installation. He signs in, then goes to personnel where he is assigned to the aviation battalion and told to report to the battalion S-1 at 1300 hours.

Mike stops by the officers' club for a quick sandwich before reporting. At 1300 hours, we find him knocking on the S-1's door. The S-1 is friendly and they talk about past assignments, mutual friends and Mike's flying experience.

Mike is introduced to the commanding officer, executive officer and some other pilots around the area. He's told he will be in the second platoon. The platoon leader, a captain, tells Mike to take the rest of the day off and be at work the following morning at 0800 hours.

Mike drives back to the motel and makes another call. We hear him say, "I'm in Company A. There are four companies and the battalion headquarters, all located on the airfield. We should be able to get them all at once. I'll expect you on Sunday. . . .

"Yes, sir. You have my address and telephone number. Good-bye."

We pick up Mike at work the following morning. He's talking to some pilots in the coffee room about the unit. Listening closely, we hear him ask, "Who are your IPs? What's the procedure for orientation rides and check rides? What type missions do you get? How are crews determined? How's the maintenance?" The questions go on and on about topics pilots always talk about. There's no reason to suspect anything other than a new pilot wanting to know all about the unit. But when we see Mike later, he's making detailed notes on the answers to his questions.

Throughout the week, we see Mike making notes on maintenance procedures, the standardization program, personnel qualifications, airfield operations, fueling procedures and training. He even has notes on the flight surgeon's office. We look over his shoulder and see him write: "The only time the flight surgeon sees the pilots is when they are taking their flight physicals. These physicals seem to be on a very impersonal basis because the flight surgeon's workload does not allow a personal relationship. If the flight surgeon is to do his job properly, he must know the man's face and not his behind."

Because he's assigned to the unit, no one suspects he has a notebook completely filled with information about the unit's operations. He has detailed information from every section in the company. He's made it a practice to drop by the club during happy hour and other times when the pilots are there. He has no trouble getting information there because most pilots like to talk about their flying. Mike seems especially interested in the harrowing experiences of young aviators and the close calls of the IPs. He likes to get IPs into discussions about their aircraft capabilities, limitations, procedures and systems. He tells one IP he would like to become an instructor and questions him about the qualifications. At the end of each day, he takes out his little book and makes notes.

STRANGER IN TOWN

On one occasion, Mike volunteers to take one of the married officer's place as airfield duty officer. During the night, he reads everything pertaining to the airfield operations section. He reads the SOP, preaccident plan, Notams and weather displays. He inspects the tower and talks at length with the operator on duty.

On Saturday, Mike stays in his motel room, compiling his notes into a readable manuscript. Sunday morning, he is awakened by a knock at the door. He opens it to three men. After greetings and handshakes, Mike calls for coffee and his visitors take off their jackets, loosen their ties and sit down. Mike briefs them on the information he has gathered. They read his manuscript and discuss each item. When they are thoroughly familiar with the information Mike has gathered, they talk about what they'll do on Monday.

The following morning, we find one of Mike's three visitors at the fire station, one at the medical station and one in operations. The telephone rings in operations and the dispatcher answers, "Operations, dispatcher speaking. What? There's been an aircraft accident 3 miles west of the field?"

At this point, Mike's visitors make their presence known. They are investigators conducting an aviation accident prevention inspection. They want to check the preaccident plan in use. After this check, one continues an inspection of the operations area, one inspects the maintenance area and the other, along with Mike, checks the remaining units.

That evening, the division aviation officer, battalion commander, operations officer and unit commanders are assembled in the conference room. Mike takes the floor. "Gentlemen, it's not our intention to embarrass anyone. Our purpose is to bring your attention to weak points in your aviation accident prevention program. During this briefing, we'll endeavor to make you aware of these so you can take corrective action.

"Let me begin by pointing out a few areas where your attention is needed. When I arrived I was given a standardization and proficiency ride by an individual who was not an IP. Paragraph 2-8, Section II, AR 95-1, states that this will be done by a qualified instructor pilot.

"In talking to the pilots of this unit and reviewing their flight records, I find no standardization rides being given to aviators on a 30-, 60- or 90-day basis. This is covered in paragraph 5-5 of AR 95-5.

"I also found no maintenance SOP, as prescribed by paragraph 5-4 of FM 1-10.

"The crash alarm system is not tested daily and it does not have an alternate, as prescribed by Appendix I, AR 95-5.

"I could go on and on. However, we are giving each of you a copy of the deficiencies we found and the appropriate regulations and references. With a little command supervision, these deficiencies could have been corrected without an inspection of this type. I recommend you use the USABAAR Guide to Aviation Resources Management for Aircraft Mishap Prevention to evaluate your unit on a periodic basis. If you use this system, it will give you a much more efficient aviation accident prevention program. Are there any questions?"

The meeting finally ends at 2300 hours. The following morning, Mike signs out and departs with the other investigators. Although this type inspection is not desirable in today's Army, I can't help but wonder if it wouldn't reduce the number of accidents and loss of lives we are now experiencing.

We distribute safety regulations and directives published by DA to try to decrease the number of accidents. Adherence to these regulations and directives is left up to the commander. We pull an IG inspection once or twice a year and look for the obvious deficiencies. Commanders generally know when inspections are due and they prepare for that inspection and that inspection only. In this fiction story, Mike was there as an inspector without anyone's knowledge. He was able to get information and see things that would not be condoned during a forewarned inspection.

Would an inspection of this type be effective? Would it make commanders take a closer look at their units? Would it make all aviators take a closer look at what they are doing, knowing they must keep their house clean lest they be evicted? Harsh? Maybe. But so was killing 489 people and destroying $146,587,161 worth of equipment in fiscal year 1969.

When was the last time you took a close look at your aviation accident prevention program? Have you gotten any new men in your unit lately? If so, do they seem to be overly inquisitive? You know it could happen. Assume Mike's identity. Take a look around your unit and see what you can find wrong in your program. Anything you find, large or small, when corrected, will make a more effective aviation accident prevention program. Don't wait for a stranger in town. Do it now!

Milan Buchan

Aircraft Accident Review and Analysis Department
USABAAR

Portions of the following were adapted from the T58 Foreign Object Damage Maintenance and Prevention Guide prepared by General Electric

FOD INGESTION

FOREIGN OBJECT DAMAGE is a subject that has been talked about, written about, emphasized and reemphasized again and again. Yet accidents continue to occur because of carelessness and negligence during maintenance of aircraft engines, particularly gas turbine engines. Army aviation environmental mission requirements frequently dictate complete reliance on engine performance. When an engine fails during low level flight over trees or other hazardous terrain, there just isn't any place to go but down. Aviators flying over hazardous terrain many times say this silent prayer, "Don't let the engine quit now." They have bet their lives and the lives of their passengers on engine performance. Do you want to be the one who causes them to lose their bets, lose them because you forgot to pick up a screwdriver, rag, socket, or stray Dzus fastener?

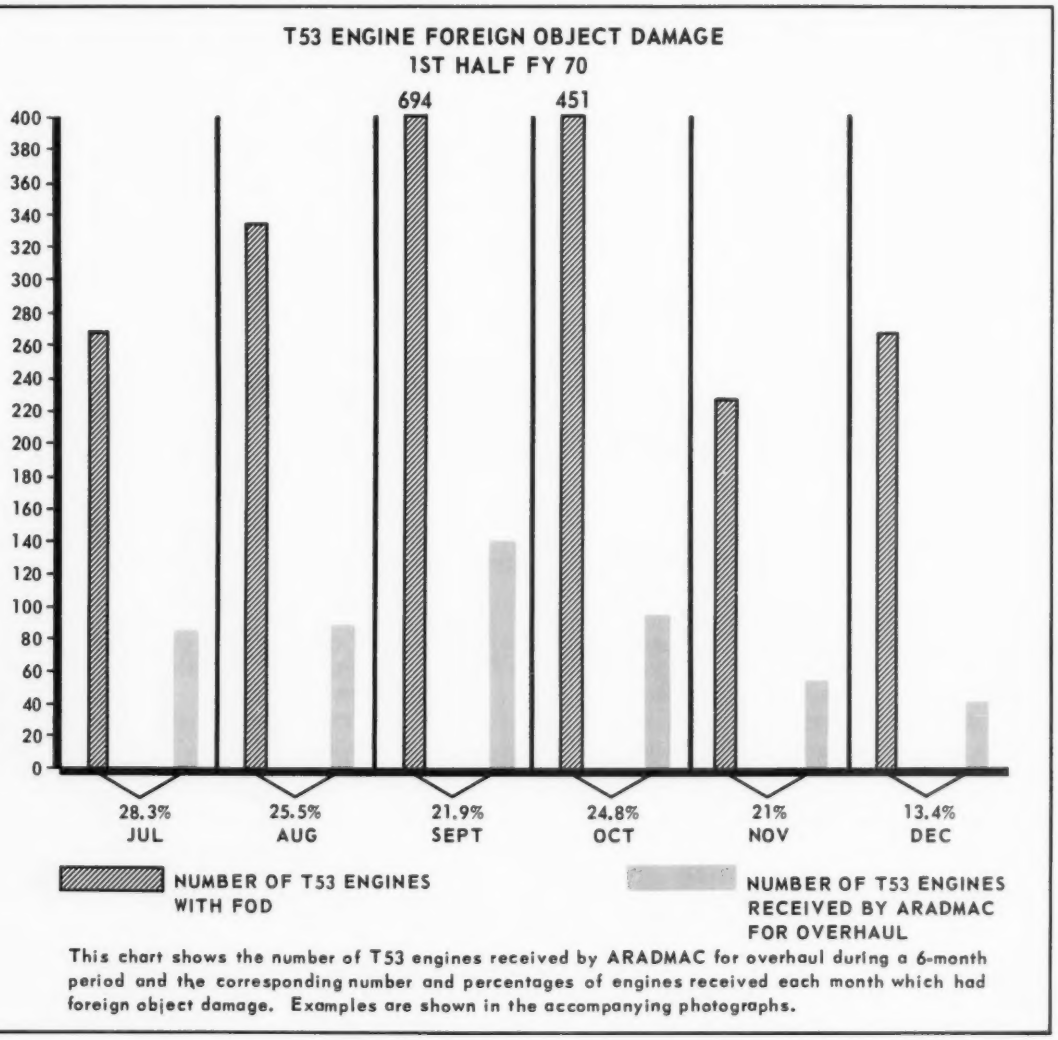
Experience has shown that aircraft configuration has a direct bearing on the type of FOD to which the engine is most susceptible. Recent major sources of FOD in T53 engines continue to be Dzus fasteners, safety wire, rivets and similar hardware. Configurations requiring frequent maintenance in the vicinity of engine inlets, or where rotor heads are immediate-

ly above the inlets, have correspondingly higher FOD susceptibility.

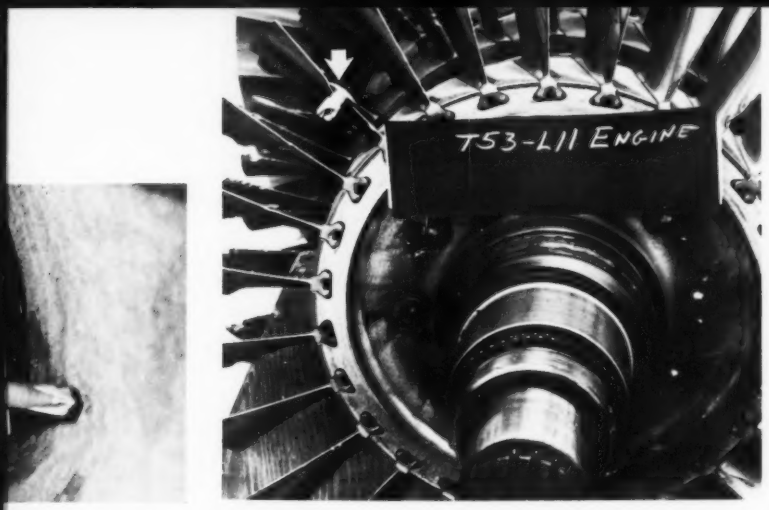
The key to prevention of foreign object ingestion is the consistent use of sound maintenance practices, including good housekeeping. Some units have been able to maintain low FOD rates while others, using the same type aircraft on similar missions, had significantly higher damage rates. This proves that sound maintenance practices and good housekeeping pay off in FOD prevention.

What do we mean by sound maintenance practices? Toolbox inventories after each maintenance

The case for toolbox inventories is evidenced by this screwdriver found in guide vanes



This chart shows the number of T53 engines received by ARADMAC for overhaul during a 6-month period and the corresponding number and percentages of engines received each month which had foreign object damage. Examples are shown in the accompanying photographs.



Dzus fastener (arrow) fits initial strike on first stage compressor blades

Mutilated Dzus fastener found lodged in fifth stage stator vanes

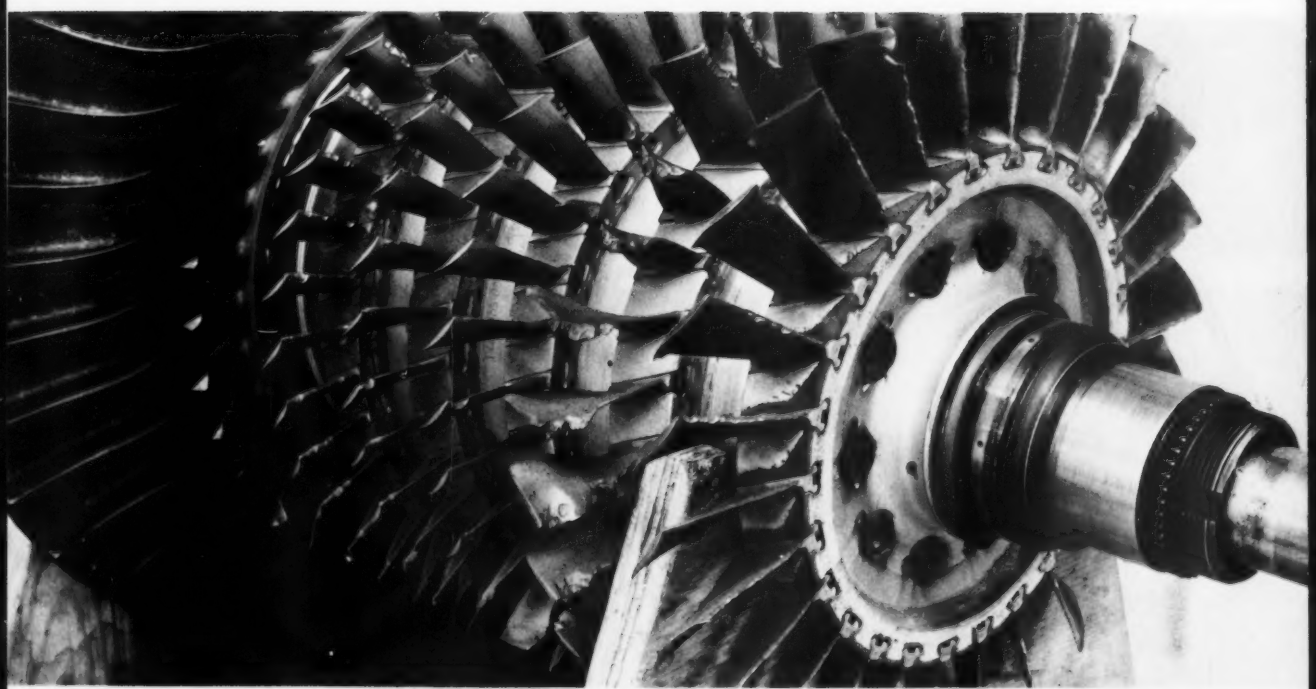
Note Dzus fastener head imprint on inlet guide vane. Letter "N" is clearly visible.

FOD INGESTION

Before

After

Each of the eight mutilated Dzus fasteners shown in this photograph represents a damaged engine

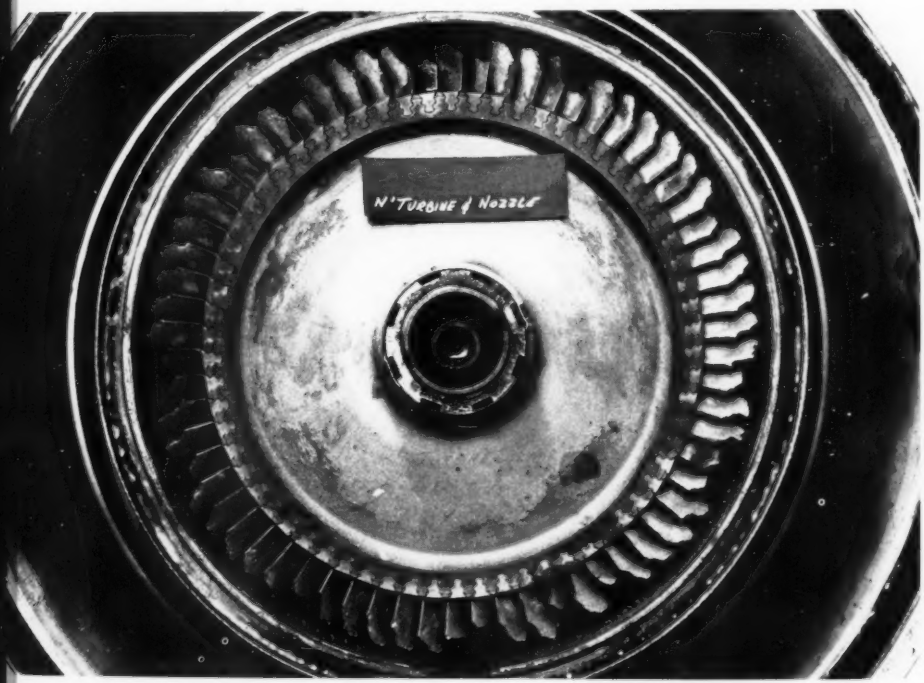


Foreign object damage to inlet guide vanes and the compressor shown in this photo resulted in engine failure and total loss of a UH-1C

Another example of foreign object damage to compressor blades

task to account for all tools and hardware. Rags and shop towels issued to maintenance personnel should be accounted for after all maintenance. All hardware dropped or misplaced during maintenance should be located and recovered. Special tools in the maintenance section should be signed out and signed in against the aircraft serial number on which they are to be used. Boot soles and heels should be checked for foreign objects before climbing on aircraft. Technical inspectors should check aircraft and maintenance areas for loose objects while inspecting maintenance performed. Crew chiefs should check for loose objects during daily inspections.

Ingestion of Dzus (turn-lock) fasteners is a major cause of FOD (see photos). It is recommended that a concentrated effort be made to instill in maintenance personnel and crew chiefs the importance of thorough inspections of inlet screens and sand/air separator and baffle areas of plenum chambers for mounting security and condition of fasteners in these areas.



Damage to compressor rotor by cotter pin or wire caused compressor stall, high egt, the burned turbine blades shown in this photo, engine failure and . . .

. . . this $28,000 accident

USAASO Sez

The U. S. Army Aeronautical Service Office discusses

Contents and use of the DOD FLIP

Distribution of an IFR plotter

Instrument Approach Procedure Chart Availability: An Army aviator reported that he recently had been cleared for an instrument approach and "lo and behold" discovered that the procedure chart for that approach was not included in the DOD FLIP. The DOD FLIP contains procedures for all military airfields, major civil air terminals, many secondary airfields and any other airfield for which there is a known operational requirement. There are situations where as many as 10 approach procedures are approved for a particular civil facility; however, only six or eight may be included in the FLIP document. Those procedures which have been printed represent known or operational requirements.

Accepting a vector to an LOC(BC) procedure Initial Approach Fix (IAF) leads to pilot/controller confusion when the pilot discovers that the assigned procedure (chart) does not exist in his flight kit. Safety may be compromised when this type ATC route handling or procedure omission occurs. Report the particulars to USAASO via the preaddressed USAASO Comment Card. The information is needed in our continuing evaluation of the ATC/FLIP policy in support of the Army mission. Discuss the issue with your safety officer, operations officer or commander. Procedure chart availability for operational missions, alternate airfield selection purposes, ATC flow control, mission requirement, contingency, plans, etc., should be carefully evaluated. If safety or operational requirements dictate, the commander should initiate a request for the procedure to be published in the DOD FLIP. Consult your FAA Flight Service Station or USAASO to determine civil locations having procedure service not contained in the DOD FLIP.

IFR Plotter: As a result of a one-time purchase, several thousand IFR plotters, 7½" x 3", were delivered to the Army in December 1969. These plotters were acquired to support the CONUS FLIP Low Altitude Enroute Charts and have been distributed to CONUS-based aviators with their 1970 annual written study guide. Aviators now in the RVN may obtain a plotter when they return to the United States by submitting a request to Department of Non-Resident Instruction, U. S. Army Aviation School, Ft. Rucker, Ala. 36360.

Concerning Instrument Procedure Charts From 1970 April Issue: A sentence was inadvertently dropped and resulted in an incorrect nomenclature for the CAIRNS AAF Charts. It should have read (starting with the first sentence): "Pilots often ask what the abbreviations and numbers found at the top of instrument procedure charts represent. Centered at the top of the Ft. Rucker, Ala., CAIRNS AAF Charts you will find AL577 (U.S. Army). On the Ft. Campbell, Ky., CAMPBELL AAF Charts you will find AL679(USAF)."

XU

Eskimo Style

A DIGEST reader has discovered the ancient mating grounds of the CH-21 in the unchartered wilderness of Alaska

Dear Sir:
While cleaning out the ancient files of accident folders and assorted safety materials accumulated by the long line of safety officers preceding me, I came across the original copies of a completed, but not submitted, DA Form 285 Accident Report. Though not immediately obvious, the reason for short-stopping the report became increasingly suspect as I read through it. The inclosed photograph has caused many laughs and comments about finding the secret mating grounds of the now almost extinct CH-21C, and also a bit of stern reflection by commanders on existing supervisory practices. Although the old bird is no longer with us, the same personnel deficiencies which put dents into the noses of these two aircraft continue to plague this and every other major Army commander. The following synopsis and witness statement quotes will expain what happened.

By 1430 hours the maintenance platoon had finished the PE on the ski-equipped CH-21C in the left of the picture. The maintenance sergeant then told the crew chief to find help and move the aircraft out on the ramp for installation of the nosewheel ski. Four personnel ground handled the aircraft.

Specialist 4: "I asked for assistance from Specialist 6 ————, ———— and Specialist 4 ————. I jumped into the cockpit and released the brakes. The aircraft was moved out onto the ramp on a slight incline [all ramps at Ft. Wainwright are level] where I set the parking brake and left the cockpit. I didn't use chocks because of the skis [nose wheel?]. About two hours later, I was cleaning equipment and I heard this crash. My helicopter had run down and busted in the nose of the other one."

Specialist 4: ". . . helped move the CH-21 out onto the ramp by pushing against the nose gear."

Specialist 6: ". . . helped move CH-21 number ———— out onto the ramp by pushing against the right main gear. This is all I had to do with the aircraft."

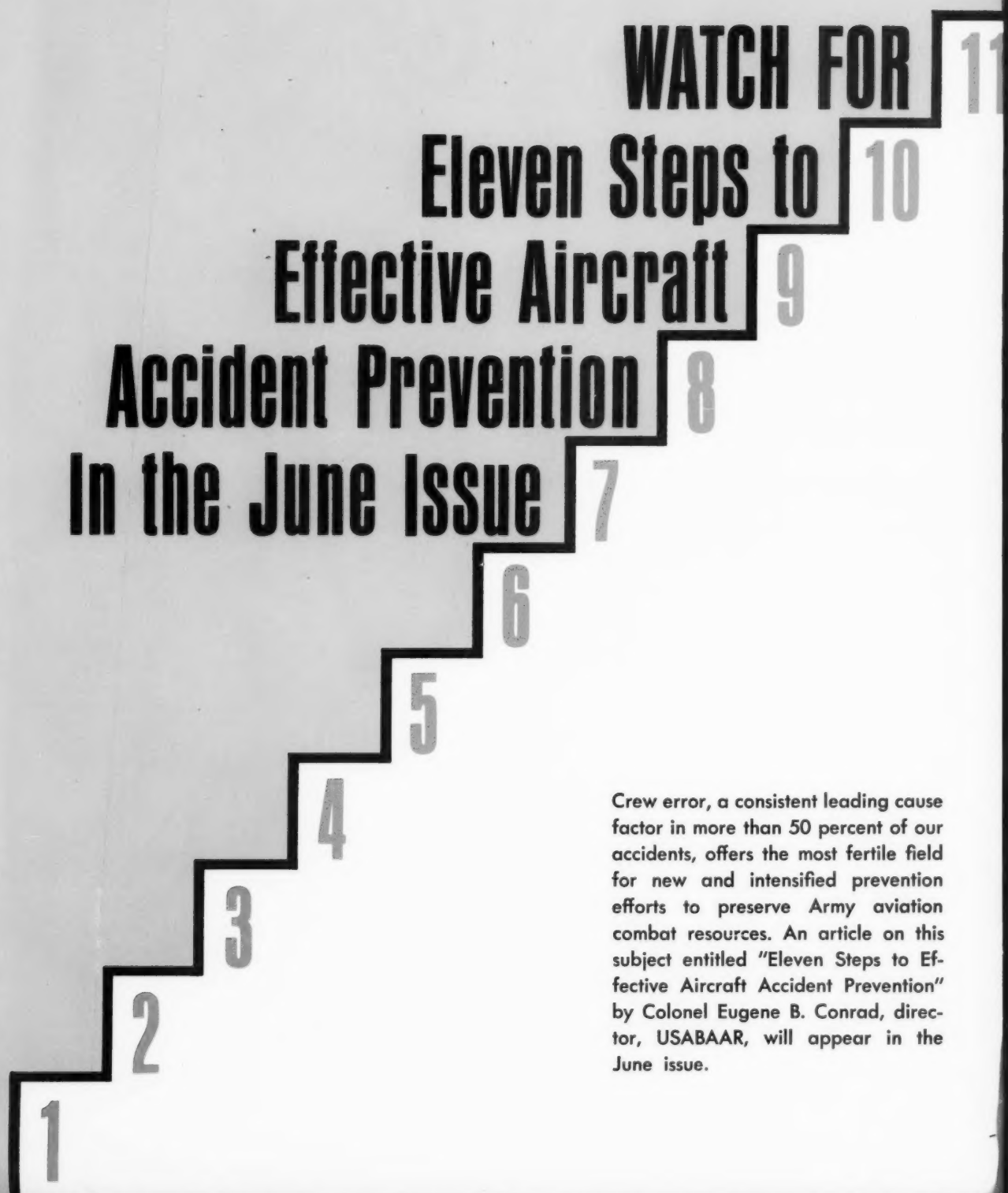
Sergeant E-6: "————, the crew chief asked me to help so I pushed against the left main gear and we moved the aircraft out of the hangar to the ramp. It was parked on a slight incline. That is all I had to do with the aircraft."

This accident occurred on 1 May 1965 and cost approximately $1,400.00. It is now too late to question the commander, personnel involved or the safety officer. The moral of the story has been put to use, however, and the elements of the accident, lack of supervision, complacency and disregard of standard procedures, have been widely and thoroughly discussed. We felt, also, that this example of glaring errors, though terminated with humorous results, should be shared with the Army aviation community. If further accident prevention benefit can be gained from the use of the inclosed photograph and accident description, please feel free to do so.

MAJ BRYAN D. HARRIS
Aviation Safety Officer, USARAL
HQ, U. S. Army, Alaska
APO Seattle 98749

WATCH FOR

Eleven Steps to Effective Aircraft Accident Prevention In the June Issue



Crew error, a consistent leading cause factor in more than 50 percent of our accidents, offers the most fertile field for new and intensified prevention efforts to preserve Army aviation combat resources. An article on this subject entitled "Eleven Steps to Effective Aircraft Accident Prevention" by Colonel Eugene B. Conrad, director, USABAAR, will appear in the June issue.